SECTION 7
OTHER IMPACTS

In addition to the impacts on CWT facilities and markets described in Section 6, indirect impacts of the CWT effluent limitations guidelines and standards may be felt by residents of the communities in which the CWTs are located, certain subsets of the population, and customers and suppliers of CWTs; the impacts may also affect the overall level of inflation in the economy. This section examines these impacts. It is important to note in examining the results presented below that they are not scaled to reflect the universe of CWT facilities. EPA chose not to scale these impacts because there is no way of knowing whether communities having CWT facilities and for which EPA has data resemble communities having CWTs and for which EPA does not have data.

7.1 COMMUNITY IMPACTS

In response to the effluent limitations guidelines and standards, commercial CWT facilities are predicted to modify the quantities of waste they treat. This change in production will be associated with changes in employment. The changes in employment predicted to occur as a result of the regulation include direct changes and indirect changes. Direct changes in employment combine changes in employment associated with the labor needed to comply with the regulation (generally increases in employment) and changes in employment associated with market adjustments to the regulation (generally decreases in employment). Indirect changes in employment are experienced elsewhere in the community as a result of the changed spending of people affected by the direct changes in employment. Because noncommercial facilities are expected to continue to treat the same quantity of waste as they treated at baseline, no market-related reductions in employment are expected to occur at noncommercial facilities. They may have to hire additional labor to implement controls to comply with the regulation.

Changes in output and employment at a CWT facility affect not only the welfare of the individual employees either hired or laid off, but also the communities in which the CWT facilities are located, because unemployed individuals have less income and spend less in the community, in addition to perhaps placing additional burdens on community services within the community. Conversely, newly employed individuals spend some of their income in the community, which increases the incomes and spending of other community residents. Direct changes in employment thus results in a multiplied community-wide impact. The U.S. Department of Commerce, Bureau of Economic Analysis (BEA) (1992) publishes estimates of direct-effect employment multipliers for each state for broad industry categories. These multipliers estimate the direct total change in employment resulting from one job gained or lost in each industry category in each state. These data can be used to estimate the total community employment impacts resulting from changes in the operations of CWT facilities.

7.1.1 Direct Employment Changes

Direct employment changes resulting from compliance with the proposed effluent limitations guidelines and standards include facility-specific changes in employment at commercial CWT facilities that result from their changes in CWT operations as a result of market adjustments to the proposed regulation. In addition, direct employment effects of the proposed regulation include the estimated labor requirements of the control. These labor requirements are estimated on a national basis and are therefore not included in the community-level analysis. It should be noted, however, that the increased employment needed to comply with the regulation will in some cases exceed the jobs lost due to market adjustments. The community impacts are therefore overestimated in the following analysis.

7.1.1.1 Facility-Specific Changes in Employment Resulting from Market Adjustments

The Agency estimated facility-specific changes in employment as facilities responded to the costs of complying with the effluent limitations guidelines and standards. As described in Section 6, the facilities were assumed to adjust employment proportional to the changes in quantity of waste accepted for treatment or recovery at the facility. These employment adjustments are in general rather small. Table 7-1 shows a distribution of the changes in employment associated with market adjustments to the regulation.

TABLE 7-1. CHANGES IN CWT EMPLOYMENT RESULTING FROM MARKET ADJUSTMENTS AT CWT FACILITIES

Change in Employment	Number of Facilities
BPT/BAT (estimated overall job losses: 40)	
No change in employment	5
Decrease by fewer than 10 jobs	6
Decrease by more than 10 jobs	1
PSES (estimated overall job losses: 298)	
No change in employment	104
Decrease by fewer than 10 jobs	37
Decrease by more than 10 jobs	6

Note: Data are not scaled to reflect the estimated universe of CWT facilities.

These changes in employment must be compared with the increased employment estimated to be required to comply with the regulation. Nationwide, 97 additional employees are estimated to be needed at CWT facilities to operate the control equipment assumed to be installed to comply with the regulation. At some facilities, the net direct change in employment may be positive. This change is not beneficial to the CWT facilities, of course, because they are in a sense being forced by the regulation to make the decision to hire employees that they otherwise would not have needed. From the point of view of the employees and the communities, however, this outcome is good. In many cases, the skills required to comply with the effluent limitations guidelines and standards are similar to the skills required to run the basic CWT operations at the facilities. Thus, the employment needs of the regulation may directly mitigate the job losses due to market adjustments, so many fewer workers may incur employment disruptions due to the regulation.

7.1.2 Community Employment Impacts

The direct market-related changes in employment at commercial CWT facilities can be used to estimate changes in total employment in the communities in which the CWT facilities are located. As noted above, the changed incomes of individuals either hired or laid off at CWT facilities will result in changes in their spending within the community. This change, in turn, will result in changes in employment at establishments throughout the community where the CWT employees transact business. The BEA direct-effect regional employment multipliers, published for broad industry categories in each state, measure the change in statewide employment expected to result from a one-job change in employment (including the initial one job change at the CWT). Table 7-2 provides the direct-effect regional employment multipliers used to estimate the total change in employment resulting from the market adjustments to CWT controls. These multipliers range from 2.91 in New York to 6.55 in Texas and average 4.05 across all states. Thus, overall each one-job direct change in employment at a CWT facility results in a statewide change in employment of between three and six jobs. While some of the indirect employment impacts may not be

TABLE 7-2. DIRECT-EFFECT REGIONAL MULTIPLIERS FOR STATES IN WHICH CWT FACILITIES ARE LOCATED

AL	5.5118	MN	3.6915
AZ	4.3034	MO	4.5339
CA	5.1316	MS	5.4638
CO	5.5710	MT	4.8590
CT	3.2796	NC	3.6247
DE	3.8990	NJ	3.8339
FL	3.4955	NV	3.0610
GA	4.0769	NY	2.9124
IA	3.9978	OH	5.1695
IL	5.3610	PA	5.6759
IN	5.3335	RI	3.2728
KS	5.4007	SC	3.9489
KY	5.4906	TN	4.4237
LA	4.9349	TX	6.5537
MA	3.3633	VA	4.7204
MD	3.9997	WA	3.8849
ME	2.8376	WI	3.4751
MI	3.6638	WV	5.0514

experienced in the community in which the CWT is located, EPA assumes that all the indirect impacts are concentrated there.

Table 7-3 is a frequency distribution of the total change in community employment resulting from the changes in CWT employment reported in Table 7-1. For direct

TABLE 7-3. CHANGES IN COMMUNITY EMPLOYMENT RESULTING FROM MARKET ADJUSTMENTS AT CWT FACILITIES

Change in Community Employment	Number of Communities
BPT/BAT	
Increase or no change	4
Decrease of less than 1 FTE	1
Decrease of 1 to 20 FTEs	3
Decrease of 20 to 50 FTEs	1
Decrease by more than 50 FTEs	1
PSES	
Increase or no change	67
Decrease of less than 1 FTE	11
Decrease of 1 to 20 FTEs	11
Decrease of 20 to 50 FTEs	10
Decrease by more than 50 FTEs	4

Note: Data are not scaled to reflect estimated universe of CWT facilities.

dischargers, changes in employment range from an increase of less than one full-time equivalent (FTE) employee to a loss of 79 employees. The median change in community employment resulting from controls on direct discharging facilities is -0.8 FTEs. For indirect dischargers, changes in community employment range from a loss of 213 FTE employees to no change in employment. Because so many indirect dischargers experience no change in employment as a result of the market adjustments, the median change in community employment resulting from controls on indirect dischargers is zero FTEs.

7.1.3 Measuring the Significance of the Community Employment Impacts

To assess the severity of these impacts on the affected communities, the Agency employed the most conservative definition of "affected community":

- It is the municipality in which the CWT facility is located, if its population is greater than 10,000.

- For CWTs located in communities with fewer than 10,000 people, the community is defined as the county in which the CWT is located (U.S. Department of Commerce, 1994).

The Agency compared the estimated change in community employment with the baseline community employment, where community is defined as described above.

A severe employment impact is estimated to occur if the change in community employment exceeded 1 percent of the baseline 1995 community employment. In no community did the change in employment exceed 1 percent of baseline community employment; therefore, no significant community impacts are predicted to result from the proposed effluent limitations guidelines and standards. Table 7-4 presents a frequency distribution of the percentage changes in community employment projected to result from the regulation.

Percentage changes in employment range from a loss of 0.29 percent of baseline employment to a gain of less than 0.001 percent as a result of the controls on direct discharging facilities. They range from a loss of 0.67 percent of baseline community employment to no change in community employment as a result of controls on indirect discharging facilities. The median change in community employment resulting from the BPT/BAT controls is -0.001 percent of baseline employment in affected communities. The

TABLE 7-4. COMMUNITY EMPLOYMENT IMPACTS

Percentage Change in Employment	Number of Communities
BPT/BAT	
No change or increase	4
Decrease by less than 0.2 percent	5
Decrease by 0.2 to 0.3 percent	1
PSES	
No change or increase	68
Decrease by less than 0.2 percent	32
Decrease by 0.2 to 0.3 percent	1
Decrease by 0.3 to 0.9 percent	2

Note: Data are not scaled to reflect estimated universe of CWT facilities.

median change in community employment resulting from PSES controls is 0 percent of baseline community employment.

7.2 DISTRIBUTIONAL IMPACTS AND ENVIRONMENTAL JUSTICE

Impacts of the CWT effluent limitations guidelines and standards include both economic impacts such as lost employment and income and environmental impacts such as cleaner surface water, with attendant reduced risks from drinking and fish consumption. Environmental justice reflects the concerns that waste management facilities are more likely to be located in communities of color or low-income communities, which may not have the resources or political power to affect the siting decisions. If CWT facilities are located in such communities, both the economic impacts and the benefits of the CWT effluent limitations guidelines and standards may be disproportionately experienced by non-Caucasian or low-income communities.

To examine the distributional impacts and the environmental justice implications of the regulation, the Agency examined both the community employment impacts and the benefits of the regulation to see if communities with higher proportions of non-Caucasian or low-income residents incurred disproportionately high employment impacts or experienced a greater or smaller than proportional share of the benefits. EPA made the conservative assumption that all the employment impacts are experienced in the immediate community where the CWT is located. Thus, distributional impacts of the regulation were evaluated by examining the ethnic and income characteristics of the communities' populations.

7.2.1 Baseline Characterization of Communities in which CWT Facilities are Located

This section characterizes communities in which CWT facilities are located by examining two specific population characteristics: the share of the population that is non-Caucasian and the share of the population with incomes falling below the poverty line. To determine if communities in which CWT facilities are located pose potential environmental justice issues, the Agency compared the non-Caucasian and poverty proportions of the community populations with those of the states in which the communities are located. This comparison helps account for differing demographic patterns in different regions of the country.

7.2.1.1 Non-Caucasian Population

For the United States as a whole, non-Caucasian groups make up 16.8 percent of the population. For communities in which CWTs are located, the non-Caucasian population share ranges from less than 1 percent to nearly 90 percent, with a median of 25.7 percent.

Approximately 25 percent of CWT communities have populations that are more than 40 percent non-Caucasian. Table 7-5 shows a frequency distribution of the percentage of the communities' populations that is non-Caucasian. Figure 7-1 compares CWT community non-Caucasian population share to state non-Caucasian population share. As the figure shows, more than 60 percent of the CWT communities have non-Caucasian population shares exceeding that of the state in which they are located by more than five percentage points. This indicates that inadequately controlled releases from CWT facilities pose a significant environmental justice concern. Thus, the Agency examined the changes in pollutant releases and risks in communities with large proportions of people of color in their populations to ensure that the CWT regulation is sufficiently protective of these populations. For this analysis, environmental benefits and economic impacts on 1) communities with populations of people of color that exceed 30 percent of the total population and 2) communities for which the community's non-Caucasian population share exceeds state non-Caucasian population share by more than 5 percentage points were examined to determine if the projected economic impacts or benefits fall disproportionately on communities of color.

7.2.1.2 Percent of Population with Incomes Below the Poverty Level

Of equal concern to the Agency is the concern that impacts may fall disproportionately on relatively low-income communities. To analyze this problem, the Agency examined the share of the population falling below the poverty level of income. For the United States as a whole, approximately 13 percent of the population falls below poverty. For CWT communities, the share of the population with incomes below poverty ranges from 2.5 percent to nearly 35 percent, with a median of 15.8 percent. Approximately 25 percent of the communities have 20 percent or more of their residents with incomes below poverty. Table 7-6 shows a frequency distribution of the percentage of communities' populations with incomes below poverty. The Agency compared CWT communities' poverty share of the

TABLE 7-5. FREQUENCY DISTRIBUTION: PERCENT NON-CAUCASIAN POPULATION IN CWT COMMUNITIES

Percent Non-Caucasian Population	Number of Communities	Percent of Communities
Less than 10 percent	32	21.9
10 to 20 percent	17	11.6
20 to 30 percent	35	24.0
30 to 50 percent	39	26.7
50 percent and above	23	15.8
Total	146	100.0

Note: Data are not scaled to reflect estimated universe of CWT facilities. Two communities are omitted due to lack of data.

Source: U.S. Department of Commerce, Bureau of the Census. *County and City Data Book, 1994.* Washington, DC: U.S. Government Printing Office, 1994.

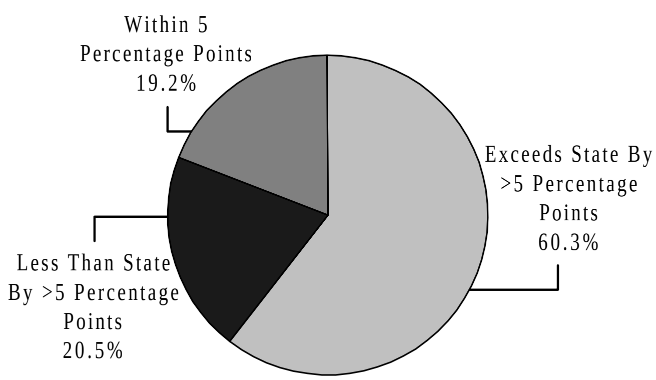

Figure 7-1. Non-Caucasian Share of Community Population Compared to State

TABLE 7-6. FREQUENCY DISTRIBUTION OF PERCENT OF POPULATION FALLING BELOW POVERTY

Percent Below Poverty	Number of Communities	Percent of Communities
Less than 7 percent	19	13.0
7 to 13 percent	33	22.6
13 to 20 percent	56	38.4
20 to 30 percent	31	21.2
30 percent and above	7	4.8
Total	146	100.0

Note: Data are not scaled to reflect the estimated universe of CWT facilities. Two communities are omitted due to lack of data.

Source: U.S. Department of Commerce, Bureau of the Census. *County and City Data Book*, *1994*. Washington, DC: U.S. Government Printing Office, 1994.

population to those of the states in which they are located to account for regional differences in income levels.

Figure 7-2 illustrates this comparison. Approximately 37 percent of communities have poverty population shares significantly (five percentage points or more) higher than those of the states in which they are located. Only about 10 percent of communities have significantly lower poverty population shares than the states in which they are located. For the majority of communities (approximately 53 percent), the community poverty population share is similar to that for the state in which it is located. For this analysis, the Agency examined impacts on communities with more than 18 percent of the population below poverty to determine whether economic impacts or environmental benefits fall disproportionately on relatively low-income communities.

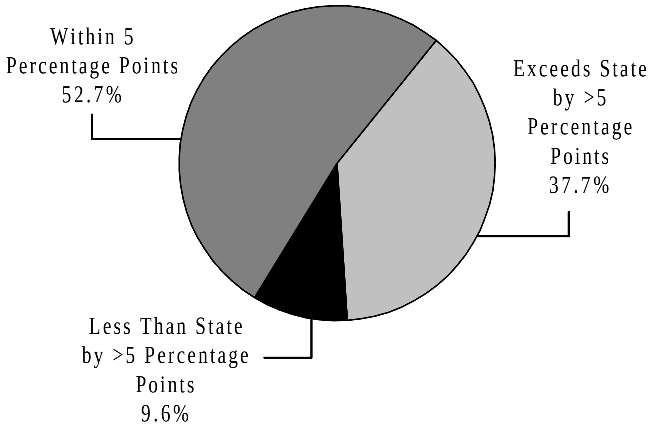

Figure 7-2. Poverty Share of Community Population Compared to State

7.2.2 Distributional Impacts of the CWT Effluent Limitations Guidelines and Standards

EPA examined employment impacts felt by communities to ensure that communities of color and relatively low income communities are not incurring disproportionately high impacts. Of the 42 communities experiencing more than one FTE job loss, 30 are communities that have relatively high non-Caucasian populations, and 26 are communities with a relatively large share of their populations below the poverty level. Thus, there is some reason for concern about the equity of the impacts on communities in which CWT facilities are located. However, the largest percentage change in employment for any community is 0.51 percent. Because the changes in community employment are so small, EPA does not believe that significant adverse employment impacts will occur in communities of color or in communities with a relatively large share of poor residents.

7.2.3 Environmental Justice Implications of the CWT Effluent Limitations Guidelines and Standards

To assess the environmental justice implications of the CWT regulation, EPA examined the benefits experienced by communities adjacent to the surface water bodies into which CWT facilities directly or indirectly discharge their wastewater. These communities are largely, but not entirely, the same as the communities in which the CWT facilities are located. EPA assumed that all the benefits of the regulation are experienced by residents of the counties adjacent to the stream reaches and other surface water that are projected to be less polluted due to the regulation. Again, communities are of concern for environmental justice if their population

- is more than 30 percent non-Caucasian,
- has a non-Caucasian share that exceeds the state's non-Caucasian share by 5 percentage points,
- has more than 18 percent of the population with income below the poverty level, or
- has a poverty share that exceeds the state's poverty share by 5 percentage points.

EPA identified 81 counties bordering stream reaches or other surface water affected by CWT direct or indirect discharges. Of the 81 counties, EPA identified 32 that may be of concern because of relatively high non-Caucasian or poor populations. Seventeen (roughly 40.5 percent) of the 32 counties for which environmental justice is a potential concern are estimated to experience benefits. This is approximately the same share of all counties (42 out of 81, or 39.5 percent) for which benefits were quantified. Thus, the CWT effluent limitations guidelines and standards are projected to improve environmental justice by reducing exposure to pollutants in 17 counties that have relatively high non-Caucasian or poor populations.

7.3 INDIRECT IMPACTS ON CUSTOMERS AND SUPPLIERS

Indirect impacts on customers and suppliers occur because the facilities adjust both their prices and their purchases of inputs in response to the regulation. In general, the Agency does not expect these indirect impacts of the CWT effluent limitations guidelines and standards to be large, although specific customers and/or suppliers may incur significant impacts.

The total costs incurred by waste generators to purchase CWT services (total CWT costs) are equivalent to the CWT revenues earned by commercial CWT facilities plus the operating costs of noncommercial CWT facilities. This amount, which is estimated to be $664.0 million, represents a very small share of the total costs of manufacturing industries. Appendix B lists quantities of waste sent off-site for treatment or recovery in 1995, according to the Toxics Release Inventory, by SIC code. These industries represent most of the customers of CWTs. To estimate the share of these SIC codes' costs represented by centralized waste treatment, the Agency used the following formula:

(Total CWT costs)/(Value of shipments for SICs 20-39)

The value of shipments for all manufacturing industries in 1996 (adjusted to 1997 dollars) is $3,732 billion. This formula may overstate the cost share of CWT services in total industrial costs, because it uses only manufacturing costs as its base. Nevertheless, it is extremely small, less than 0.001 percent. This small cost share suggests that increases in CWT prices will not result in significant changes in the operating costs of manufacturing industries or in the prices of goods and services whose production generates the demand for CWT services. It should be noted, however, that while the costs of CWT services are a small share of manufacturing costs overall, the increased price of CWT services resulting from the regulation may result in significant impacts for individual waste generators or individual input suppliers. It is not possible for the Agency to isolate these individual impacts.

Because the CWT industry is relatively small, changes in its demand for inputs is not expected to have a significant impact on input prices. The inputs to the production of CWT services include labor, chemicals, and energy. Impacts on labor are discussed above. The chemicals used by CWTs in treatment or recovery operations are also used in many chemical manufacturing activities. In general, CWTs represent a small share of the demand for these chemicals. Thus, the CWT regulation is not expected to result in significant impacts on suppliers of these chemicals. Likewise, CWTs' demand for energy is a small share of industrial demand for most utilities. Thus, the CWT regulation is not expected to have a significant impact on energy suppliers.

7.4 IMPACTS ON INFLATION

The Agency does not expect the CWT effluent limitations guidelines and standards to result in significant impacts on inflation. The prices of CWT services are expected to increase, in some cases substantially. This increase in CWT prices increases the cost of production for generators demanding CWT services. This, in turn, may cause them to increase their prices. However, because the cost of CWT services is generally a small share of the total cost of production for most manufacturing industries, as discussed in the preceding section, the Agency does not anticipate significant increases in the prices of manufactured commodities whose production results in the generation of the wastes managed at CWT facilities. Thus, no overall inflationary pressure is expected to result from the regulation.

7.5 REFERENCES

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U.S. Department of Labor, Bureau of Labor Statistics. Producer Price Index-Commodities. Series ID: WPU00000000, All Commodities. <http://146.142.4.24/cgi-bin/surveymost>. Data extracted on September 11, 1998.

SECTION 8

INITIAL REGULATORY FLEXIBILITY ANALYSIS

This section considers the effects that the proposed effluent limitations guidelines and pretreatment standards may have on small businesses in the CWT industry.

8.1 THE REGULATORY FLEXIBILITY ACT (RFA) AS AMENDED BY THE SMALL BUSINESS REGULATORY ENFORCEMENT FAIRNESS ACT (SBREFA)

The purpose of the Regulatory Flexibility Act (RFA) is to establish as a principle of regulation that agencies should tailor regulatory and informational requirements to the size of entities, consistent with the objectives of a particular regulation and applicable statutes. The RFA provides that whenever an agency is required to publish a general notice of rulemaking for a proposed rule, the agency generally must prepare (and make available for public comment) an initial regulatory flexibility analysis (IRFA). This analysis or a summary of the analysis must be published in the Federal register at the time of publication of a proposal. The requirement to prepare an IRFA does not apply to a proposed rule if the head of the agency certifies that the proposal will not, if promulgated, have a significant impact on a substantial number of small entities. If, based on an initial assessment, a proposed regulation is likely to have a significant economic impact on a substantial number of small entities, the RFA requires an IRFA. This analysis includes a justification for the regulation, a description of the affected entities, and a discussion of regulatory alternatives. This chapter presents that analysis.

In addition to the preparation of an analysis, the RFA, as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA), imposes certain responsibilities on EPA when it proposes rules that may have a significant impact on a substantial number of small entities. These include requirements to consult with representatives of small entities about the proposed rule. The statute requires that, where EPA has prepared an initial RFA, EPA must convene a Small Business Advocacy Review (SBAR) panel for the proposed rule to seek the advice and recommendations of small entities concerning the proposal. The panel is composed of employees from EPA, the Office of Information and Regulatory Affairs within the Office of Management and Budget, and the Office of Advocacy of the Small Business Administration (SBA).

The RFA defines a "small entity" as a small non-for-profit organization, small governmental jurisdiction, or small business. Small government entities are defined in the RFA as those jurisdictions with fewer than 50,000 people. In general, the SBA, for specific industries, sets size standards to define small businesses by number of employees or amount of revenues. These size standards vary by SIC code. Over 70 percent of the CWTs responding to the Waste Industry Questionnaire indicated an SIC code of 4953, "Refuse Systems" (see Table 3-4). For this SIC code, SBA defines a small business as one receiving less than $6 million/year, averaged over the most recent three fiscal years (SBA, 1996).

8.2 INITIAL ASSESSMENT

During development of this proposal, EPA undertook a preliminary assessment to determine the economic effect of the options being considered for proposal on small CWT companies. Based on this initial evaluation, EPA concluded that, if EPA adopted limitations and standards based on some of the options being considered for proposal, the impact on some small CWT companies might be significant. As discussed below, this would be particularly true with respect to CWT facilities that treated oily waste. Most of the small businesses potentially affected by the proposal would be found in this subcategory. While the total number of small businesses engaged in CWT operations was not large—EPA currently estimates that nationally, there are 63 small businesses that own discharging CWT facilities—the potential costs for seventy-one percent of these companies would exceed 3 percent of their revenue (without adjusting for any potential for the CWTs to pass through increased costs of operations to their customers).

Given that EPA's assessment showed several of the proposed options would have economic effects described above, EPA decided to prepare an IRFA. In addition, in November 1997, EPA convened a SBAR Panel for this proposed rule to collect the advice and recommendation of small entity representatives (SERs) of CWT businesses that would be affected by the proposal.

8.3 THE INITIAL REGULATORY FLEXIBILITY ANALYSIS

The IRFA must include a discussion of the reason the agency is considering the proposed rule, as well as the objectives and legal basis for the proposal. It must also include a description and estimate of the number of small businesses that will be affected. It must describe the reporting, recordkeeping, and other compliance requirements of the proposed rule and must identify any federal rules that may duplicate, overlap, or conflict with the proposed rule. Finally, the IRFA must describe any significant regulatory alternatives to the rule which would accomplish the stated objectives of the applicable statutes and which minimize any significant impacts on small businesses (EPA, 1997).

8.3.1 Reason EPA is Considering the Proposed Rule

A detailed discussion of the reason for the proposed rule is presented in Section I.X of the preamble and EPA's development document supporting the rule (EPA, 1998a). A brief summary may also be found in Section 9.1.2.

8.3.2 Objectives and Legal Basis for the Proposed Rule

A detailed discussion of the objectives and legal basis for the proposed rule is presented in Sections I and II of the preamble to the proposed rule and Chapter 1 of EPA's development document supporting the rule (EPA, 1998a).

8.3.3 Description and Estimation of Number of Small Entities to Which the Regulation Will Apply

To analyze the impacts of the proposed rule on small companies, EPA compiled data on the companies owning CWT facilities. The company data come from a variety of sources (see Section 2). These include the 1991 Waste Treatment Industry Questionnaire and public comments on the 1995 proposal and the Notice of Data Availability. EPA obtained other financial data were collected from publicly available sources. Questionnaire responses, generally referring to 1989 company financial conditions, have been adjusted to 1997 dollars. Data from other sources were collected for 1995 and adjusted to 1997 dollars. During the years since these data were collected, there may have been considerable change in the ownership of facilities and the financial status of companies. In fact, EPA has information that, due to consolidations in the CWT industry, some of the CWT businesses counted as small businesses (based on 1989 or 1995 data) in this analysis are no longer small because they now have higher revenues or have been purchased by larger companies. Reported impacts on small CWT businesses may therefore be overstated. However, these data represent the most complete information available for the industry and are consistent with the facility engineering and economic characterization used in the analysis.

There are no nonprofit organizations or small governmental operations that operate CWT facilities. This analysis therefore focuses only on small businesses. For SIC code 4953, Refuse Systems, small business concerns are those companies receiving less than $6 million in annual sales. Based on this criterion, there are 82 companies operating CWT facilities that would be classified as small entities. Sixty-three of these companies own discharging CWTs that are potentially subject to the proposed limitations and standards.

8.3.4 Description of the Proposed Reporting, Recordkeeping, and Other Compliance Requirements

The proposed rule does not contain any specific requirements for monitoring, recordkeeping, or reporting. Regulations for the existing NPDES and national pretreatment programs already contain minimum requirements, although control authorities establish the monitoring regime for individual facilities (see also Section 8.3.6). (Since there are no new monitoring, recordkeeping, or reporting requirements for this rule, there are no professional skills necessary to meet any new requirements.)

8.3.5 Identification of Relevant Federal Rules that May Duplicate, Overlap, or Conflict with the Proposed Rule

All direct CWT dischargers must already comply with regulations associated with wastewater permits, and all indirect dischargers are regulated by local limits and pretreatment provisions. However, the SBREFA Small Business Advocacy Review Panel did not identify any federal rules that duplicate or interfere with the requirements of the proposed rule (EPA, 1998a).

8.3.6 Significant Regulatory Alternatives

EPA considered a number of measures to mitigate the effect of the proposal on small businesses.

(a.) *Relief from monitoring requirements*. EPA did, in estimating the costs and impacts of the proposal, assume a monitoring regime. Monitoring costs make up a substantial portion of compliance costs. The proposed limitations and standards would not include any specific monitoring requirements for CWTs. therefore, establishment of specific monitoring requirements for CWTs owned by small businesses is not an alternative to the proposed rule. EPA's NPDES and pretreatment program regulations require monitoring by both direct and indirect dischargers to demonstrate compliance with discharge limitations and pretreatment standards with the frequency of monitoring established on a case-by-case basis dependent on the nature and effect of the discharge but in no case less than once a year. Consequently, local permitting authorities, under these regulations, have considerable discretion in determining the frequency of monitoring and are free to establish more frequent monitoring than specified by EPA. Because a significant portion of the costs of complying with CWT limitations and standards is related to monitoring costs, EPA examined approaches to reduce these costs. EPA considered two options. The first is the use of an indicator parameter as a surrogate for regulated organic pollutants. Instead of being required to monitor for a series of organic pollutants, the discharger would only need to measure the one, indicator parameter. The second option is for EPA to develop guidance for distribution to permitting authorities that would recommend a reduced monitoring regime for small businesses. This second option could also be combined with the first. A reduced monitoring option is analyzed in Section 8.4.

(b.) *Other regulatory relief for oily waste treaters.* The bulk of small CWT businesses are indirectly discharging oily waste (used oil) treatment companies. Among the relief measures the Agency considered are the following:

- Whether the scope of the proposal should be limited to CWT facilities other than small businesses. Whether the scope of the proposal should be confined to facilities treating oily waste flows greater than 3.5 million gallon per year (or 7 million gallons per year). These options are analyzed as specific regulatory options in Section 8.4.

- Pretreatment standards for oily waste treaters based on a less costly treatment option (emulsion breaking and secondary gravity separation) than dissolved air flotation. This treatment option is discussed with the other technology options considered for the oils subcategory as the basis for today's proposal in Section IX.B.ii of the preamble.

- Development of a streamlined procedure for obtaining a variance from categorical pretreatment standards through group applications. The CWA authorizes EPA to grant a variance from categorical pretreatment standards for facilities that, under specific circumstances, establish that their facility is "fundamentally different" with respect to the factors considered in establishing the categorical standard. EPA discusses this relief option in Section XIV.C of the preamble.

(c.) *New source performance standards for metal-bearing waste treaters.* EPA's assessment of the technology chosen as the basis for proposed new source performance standards (NSPS) and pretreatment standards for new sources (PSNS) was based on an analysis for existing sources and may not accurately reflect the costs and effluent reductions for that option for new sources. However, the analysis for existing sources indicates that the proposed NSPS option has higher costs with relatively low effluent reductions compared to the proposed BAT option. EPA has therefore examined the flexibility under the CWA to propose a less stringent option for new sources. This concern is addressed in Section XI.H of the preamble.

In addition to examining these targeted options, EPA considered three general options that would mitigate the impacts of the regulation on small entities. First, EPA proposed regulatory options that were in the form of effluent limitations guidelines and standards, not specific requirements for design, equipment, work practice, or operational standards. This option would reduce impacts on all facilities regardless of size by allowing operators to choose the least costly mix of process changes and new control equipment that would meet the limitations. Second, the Agency considered less stringent control options for each of the treatment subcategories than were originally proposed in 1995. Third, EPA selected a technology basis for pretreatment standards for the oils subcategory which generally provides less stringent standards than the technology basis for the proposed BAT limitations.

8.4 IMPACTS ON SMALL BUSINESSES

This section examines the projected impacts of the proposed CWT effluent limitations guidelines and standards on small businesses using the methods described in Section 5. First, the impacts of the combined regulatory option are discussed. Then, EPA discusses the estimated impacts under some of the various regulatory alternatives described in Section 8.3.6.

The CWT industry is composed of an estimated 164 businesses (as discussed in Section 3, this number is scaled up to reflect to total universe of CWT companies). Small companies make up more than half of all companies in the CWT industry (an estimated 82 of 164). All of these small companies, except for one, operate single CWT facilities. One company in the analysis operates two facilities. Sixty-three small companies own discharging facilities (61 own indirect dischargers and 2 own direct dischargers). Fifty-nine of these small companies are in the oil treatment/recovery business. The number of employees at each of these companies ranges from 2 to 94, with a median of 12.

8.4.1 Estimated Small Business Impacts of the Combined Regulatory Option

Estimated 1997 revenues for the 82 small companies that own CWTs (including zero dischargers) ranged from about $22,000 to $5,400,000, with a median value of approximately $2 million. Under EPA's analysis, forty-five of the 63 small companies that own discharging facilities would incur costs exceeding 1 percent of sales, and 25 out of 63 would incur costs exceeding 3 percent of sales.

Because the cost-to-sales comparison does not take into account many factors (such as the ability of CWTs to pass costs along to their customers or that post-compliance revenues may increase for some CWTs), the cost-to-sales comparison is a crude measure of impacts on small businesses. EPA therefore examined these impacts using the other methods described in Section 5 for examining impacts on facilities and firms.

Out of 56 small companies for which the Agency has reliable data on baseline profits, 42 own indirect discharging facilities and two own direct dischargers. Of the small companies owning indirect dischargers, 32 are projected to experience decreased profit margins and 10 are projected to have increased profit margins as a result of the regulation. As noted in Section 6, changes in median profit margin indicate that some small companies would benefit significantly from the regulation. The median profit margin for companies with sales of less than $6 million would increase by over 33 percent as a result of the regulation. Overall, small companies are estimated to fare better than either medium or large companies. The median profit margins for medium-sized companies increase by a smaller amount, while large companies will have decreased median profit margins.

Median return on assets (ROA) is estimated to increase by almost 19 percent for small companies as a result of the regulation. Of the 15 small companies with asset data, 12 own indirect dischargers and three own zero discharging facilities. Seven of the small companies owning indirect dischargers experience decreases in their ROA, three experience increases in their ROA, and two experiences no change in their ROA.

This analysis indicates that eight small companies would close their CWT operations as a result of the combined regulatory option. These closures are estimated to result in the loss of 162 jobs.

8.4.2 Impacts of the Small Business Relief Regulatory Options

As noted in Section 8.3.6, as a regulatory alternative, EPA considered not including small businesses within the scope of the proposal. EPA examined several bases for a limitation such as the volume of wastewater flow, employment, or annual revenues. The objective was to minimize the impacts on small businesses consistent with achieving CWA objectives. EPA is defining small CWT businesses according to the SBA size definition of $6 million in annual revenue but considered others that would be easier to implement in practice because EPA assumed that a firm-level revenue definition might be difficult to implement. EPA examined the correlation between these criteria and the size definition to target relief to small businesses.

Because most CWTs have similar numbers of employees regardless of their size, EPA first eliminated employment as a basis for establishing a small business limitation. While EPA also found no correlation between annual volume of wastewater and the size of a facility, EPA retained this criteria due to the anticipated ease in implementing a limitation based on this criteria. If a limitation based on volume of wastewater is ultimately selected, however, the limitation would place both small and large businesses outside the scope of the proposal. EPA evaluated the economic impacts of the regulatory options suggested to provide relief to small businesses during the SBREFA panel discussions. The analyzed options were all based on the combined regulatory option with costs reduced for some facilities the regulation limited to some facilities. Five relief scenarios were examined:

- Scenario 1: Assume less frequent monitoring requirements on indirect discharging CWT facilities owned by small businesses.
- Scenario 2: Limit the proposed rule to all indirect discharging facilities that accept hazardous waster or indirect discharging facilities that accept only nonhazardous waste and that have flows more than 3.5 million gallons per year.
- Scenario 3: Limit the proposed rule to all indirect discharging facilities having flows more than 3.5 million gallons per year.
- Scenario 4: Limit the proposed rule to all indirect discharging facilities that accept hazardous waster or indirect discharging facilities that accept only nonhazardous waste and that have flows more than 7.5 million gallons per year.
- Scenario 5: Limit the proposed rule to all CWT facilities not owned by small businesses.

Of the five regulatory scenarios considered to provide relief to small companies, only two, Scenarios 1 and 5, directly target CWT facilities owned by small companies. The other three scenarios target CWT facilities that are small in terms of their annual flow of CWT wastewater discharged. These low flow *facilities* may or may not be owned by small *companies*. The results of these analyses are summarized below. Table 8-1 shows the number of small businesses incurring costs that exceed 1 percent and 3 percent of company sales. For comparison, the screening analysis for the combined regulatory option with no limitations or cost reductions is also presented.

Small businesses would incur no costs at all under Scenario 5 because the regulation would not include them. Under all the other regulatory scenarios, fewer small businesses

TABLE 8-1. COMPLIANCE COST-TO-SALES SCREENING ANALYSIS FOR REGULATORY SCENARIOS DESIGNED TO PROVIDE RELIEF TO SMALL COMPANIES

	Small Companies with Costs Exceeding 1 Percent of Sales		Small Companies with Sales Exceeding 3 Percent of Sales	
Regulatory Scenario	**Companies Owning Direct Dischargers**	**Companies Owning Indirect Dischargers**	**Companies Owning Direct Dischargers**	**Companies Owning Indirect Dischargers**
Combined regulatory option with Oils 8	2	43	2	23
Combined regulatory option with Oils 9	2	52	2	33
1. Reduced monitoring for small companies	2	32	2	14
2. Limit to all hazardous and nonhazardous >3.5 mg/y	2	27	2	18
3. Limit to >3.5 mg/y	2	22	2	14
4. Limit to all hazardous and nonhazardous >7.5 mg/y	2	22	2	18
5. Limit to not small companies	0	0	0	0

Note: The results have been scaled to reflect the estimated universe of CWT facilities. Results are unadjusted for cost pass-through or postcompliance changes in revenue.

would incur significant costs compared to the combined regulatory option. Under both Scenarios 1 and 3, the number of small businesses incurring costs greater than 3 percent of sales is reduced from 25 to 16.

The Agency also estimated the number of potential facility closures and process closures for small businesses. The results of these analyses are summarized in Table 8-2. All of the scenarios developed to reduce the burden on small businesses result in somewhat lower impacts than the combined regulatory option. Scenario 5, which includes no small

TABLE 8-2. IMPACTS ON FACILITIES OWNED BY SMALL BUSINESSES

	Process Closures at Facilities Owned by Small Businesses		Closures of Facilities Owned by Small Businesses	
Regulatory Scenario	**Direct Discharging Facilities**	**Indirect Discharging Facilities**	**Direct Discharging Facilities**	**Indirect Discharging Facilities**
Combined regulatory option with Oils 8	0	5	0	7
Combined regulatory option with Oils 9	0	8	0	8
1. Reduced monitoring for small companies	0	5	0	4
2. Limit to all hazardous and nonhazardous >3.5 mg/y	0	5	0	3
3. Limit to >3.5 mg/y	0	2	0	0
4. Limit to all hazardous and nonhazardous >7.5 mg/y	0	5	0	3
5. Limit to not small companies	0	0	0	0

Note: The results have been scaled to reflect the estimated universe of CWT facilities.

businesses, has the greatest effect in reducing the impacts on facilities owned by small businesses. Reduced monitoring for facilities owned by small businesses reduces impacts on those facilities and processes only slightly. The third regulatory scenario, which limits the regulation to facilities with flows greater than 3.5 million gallons per year, also reduces impacts significantly.

EPA and other industry representatives believe, however, that the predicted outcomes of any of the potential limitations and the nature of the CWT business, in general, do not support the need for a limitation. CWT facilities are in the business of treating wastes from other facilities. As such, they provide an alternative to on-site treatment of industrial wastes.

EPA believes that the absence of categorical standards for CWTs has been a major "loophole" in a national program to control industrial pollution, allowing wastes to be treated off-site less effectively than would be required of the same wastes if treated on-site. In fact, as noted in Section X of the preamble, in general, performance at CWT facilities is uniformly poor when compared to on-site treatment at categorical facilities.

One of EPA's primary concerns with any of the limitations is that they represent one snapshot of a rapidly changing industry. If a segment of the industry is not subject to national regulation, these companies might quickly expand leading to much greater discharges within a few years than predicted by existing data—with environmentally deleterious consequences. In addition, EPA believes that most CWT facilities have substantial amounts of unused capacity. Because this industry is extremely competitive, by limiting the scope of the CWT rule, EPA could actually be encouraging ineffective treatment while discouraging effective treatment.

In summary, in an effort to provide limitations to mitigate small business impacts and still preserve the benefits of the rule, EPA considered a variety of potential limitations but found no single, effective solution to incorporate into the proposal.

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SECTION 9
COSTS AND BENEFITS OF THE CWT EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS

Pursuant to Executive Order 12866, this section compares the costs and benefits that are expected to accrue to society if EPA adopts the proposed CWT effluent limitations guidelines and standards. To gain an overall understanding of whether adoption of the proposed regulation will improve society's well-being, the Agency compares the costs that the proposal would impose on society with any benefits it may confer. This report first characterizes costs imposed by the regulation and then quantifies and monetizes them (attaches dollar values to them). Similarly, the study identifies, characterizes and, to the extent possible, quantifies and monetizes the benefits. If the benefits exceed the costs, society will be better off as a result of the regulation. However, and accurate comparison of benefits and costs is difficult because not all benefits can be quantified and monetized.

9.1 INTRODUCTION

EPA's analysis concludes that the proposed effluent limitations guidelines and standards for the CWT industry will to reduce the discharge of pollutants by at least 14.3 million pounds per year of conventional pollutants and 4.1 million pounds per year of toxic and nonconventional pollutants. EPA expects this reduction in pollution to improve water quality and reduce health risks to exposed individuals. In addition, the improved water quality will confer benefits on recreational users of the affected water bodies. To obtain these improvements, the study estimates that CWT facilities will spend $27.8 million (before tax savings) to implement the BAT and PSES controls. This section of the report examines the costs and benefits of the regulation in detail, and compares them to the extent feasible, to determine whether society realizes net benefits from the regulation.

9.1.1 Requirements of Executive Order 12866

Executive Order (EO) 12866 requires that, for significant regulations, the Agency "shall ...propose or adopt a regulation only upon reasoned determination that the benefits of the intended regulation justify its costs." Regulations are deemed significant if the regulation

- has an annual effect on the economy of $100 million or more or adversely affects in a material way the economy; a sector of the economy; productivity; competition; jobs; the environment, public health or safety; or state, local, or tribal governments or communities;
- creates a serious inconsistency or otherwise interferes with an action taken or planned by another agency;
- materially alters the budgetary impact of entitlements, grants, user fees, or loan programs, or the rights and obligations of recipients thereof; or
- raises novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this EO.

While EPA expects the CWT effluent limitations guidelines and standards to cost much less than $100 million per year, the regulation will require significant changes in wastewater treatment for the CWT industry. As a result, the Agency chose to perform an economic analysis in compliance with the requirements of EO 12866. This order requires an economic analysis that assesses the benefits and costs anticipated from the regulatory action, together with a quantification of as many of those benefits and costs as can be quantified, and a description of the underlying analysis of the benefits and costs. Sections 9.2 and 9.4 present the Agency's analysis of costs and benefits, respectively.

9.1.2 Need for the Regulation

Congress adopted the CWA to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (Section 101(a), 33 U.S.C. 1251(a)). To achieve this goal, the CWA prohibits the discharge of pollutants into navigable waters except in compliance with the statute. The primary means the CWA uses to restore and maintain water quality is establishing restrictions on the types and amounts of pollutants discharged from various industrial, commercial, and public sources of wastewater.

Facilities that discharge pollutants directly to surface water must comply with effluent limitations in National Pollutant Discharge Elimination System (NPDES) permits. Indirect discharging facilities, which discharge pollutants to sewers flowing to POTWs, must comply with pretreatment standards that are established for those pollutants in wastewater from indirect dischargers, which may pass through or interfere with POTW operations. National limitations and standards are established by regulation for categories of industrial dischargers and are based on the degree of control that can be achieved using various levels of pollution control technology.

CWT facilities may accept a wide variety of wastes from a wide variety of customers, wastes classified as hazardous or nonhazardous under RCRA. The adoption of the increased pollution control measures required by the CWA and RCRA regulation was a significant factor in the formation and development of the CWT industry. Because facilities that do not discharge their wastewater are not subject to the requirements of the CWA, many industrial facilities covered by other effluent limitations and guidelines have made process modifications to reduce the volume of wastewater they generate and have chosen to send the remaining wastewater off-site to a CWT facility for treatment.

EPA believes that any waste transferred to an off-site CWT facility should be treated to at least the same level as required for the same wastes if treated and discharged on-site at the manufacturing facility. In the absence of appropriate regulations to ensure at least comparable or adequate treatment, the CWT facility may inadvertently offer an economic incentive for increasing the pollutant load to the environment.

In collecting data to develop the CWT effluent limitations guidelines and standards, EPA identified a wide variation in the level of treatment provided by CWT facilities. Often, pollutant removals were poor, sometimes significantly lower than would have been required had the wastewaters been treated at the site where they were generated. In particular, EPA's survey indicated that some facilities were employing only the most basic pollution control equipment and, as a result, achieved low pollutant removals compared to those that could easily be achieved by using other readily available pollutant control technology. EPA had difficulty identifying more than a handful of facilities throughout the CWT industry that were achieving optimal removals. Compliance with the proposed effluent limitations guidelines and standards would ensure that all waste accepted by CWT facilities is adequately and appropriately treated prior to discharge.

9.2 SOCIAL COST OF THE RULE

The effluent limitations guidelines and standards would impose costs on society. The cost of a regulation should represent its opportunity cost, which is the value of the goods and services that society foregoes to allocate resources to the pollution control activity. This section describes EPA's estimate of the CWT effluent limitations guidelines and standards' cost to society. Because the economic impacts of the regulation were estimated based on compliance costs after deductions and other tax savings, the computation of social cost involves summing the costs to producers, consumers, and government (costs that were transferred to the taxpayer through the tax provisions of the law but represent part of the cost of compliance with the regulation).

9.2.1 Aggregate Costs to Consumers and Producers

This analysis computes the social cost of the regulation by summing the costs to consumers, producers, and government. This section discusses the costs experienced by producers and consumers, Section 9.2.2 discusses the costs to government.

As discussed in Section 5, the CWT regulation increases the cost of providing CWT services, thus shifting the industry supply curve upward from S_1 to S_2 in Figure 9-1.[1] Markets respond to these increased costs by increasing market price and reducing the quantity of waste being treated or recovered in each CWT operation (P_2 and Q_2 in Figure 9-1). Using a market-based economic impact model EPA has estimated the with-regulation price and quantity, P_2 and Q_2, for each affected CWT market. This analysis then computed the social costs of the regulation by summing the changes in the net benefits to customers and producers of CWT services, based on changes in market price. In essence, the demand and supply curves for CWT services used to generate estimates of P_2 and Q_2 are now being used, in turn, as valuation tools, to value the changes in welfare experienced by producers and consumers of CWT services.

This approach to computing social cost divides society into producers and consumers of the regulated commodity. In a market environment, consumers and producers of the good

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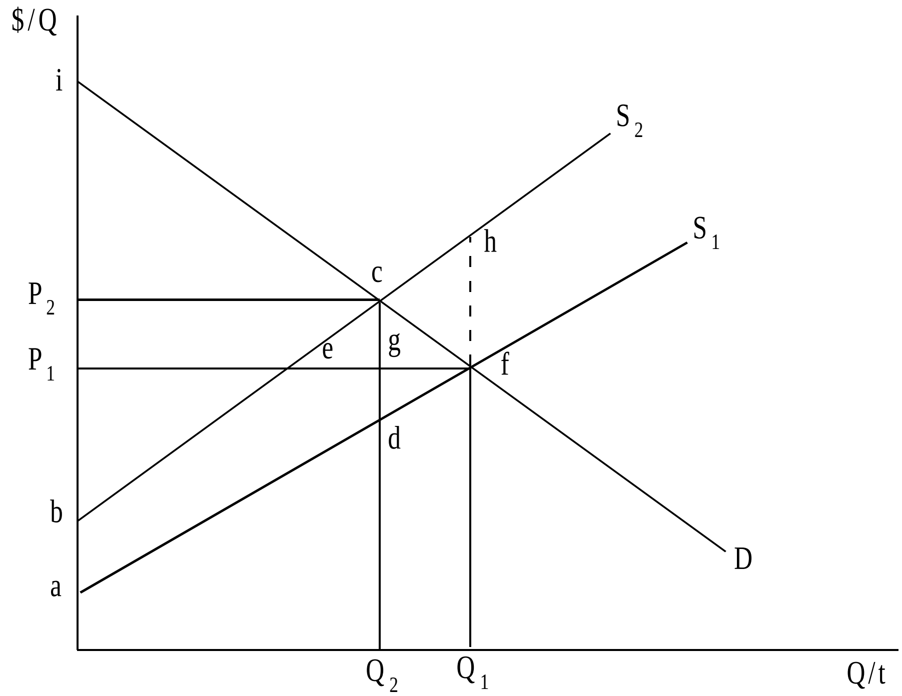
[1] Figure 9-1 is a simplification of the actual computations made to compute social cost; it is a graphical representation of social cost in a perfectly competitive market. Several CWT markets are either monopolies or duopolies; imperfectly competitive firms choose the quantity of CWT services that equates the with-regulation marginal cost with marginal revenue, not price. Conceptually, the computation of social cost is independent of market structure. The computation of social cost for imperfectly competitive firms is discussed in detail in a memorandum to the record (Heller and Fox, 1998).



1. loss in consumers' surplus P_2cfP_1
2. loss in producers' surplus abef
3. gain in producers' surplus P_2ceP_1

Total loss in social surplus (social cost) = P_2cfP_1 + abef – P_2ceP_1 = abcf

Figure 9-1. Social Cost Computed as Changes in Social Surplus

or service derive welfare from a market transaction. The difference between the maximum price consumers are willing to pay for the commodity and the price they actually pay is referred to as "consumers' surplus." Consumers' surplus is measured as the area under the demand curve and above the price of the product (P_1if at baseline and P_2ic after market adjustment to the regulation). Note that in the case of an intermediate good such as CWT services, the consumers of the service are in fact producers of other goods and services. Similarly, the difference between the minimum price producers are willing to accept for a good and the price they actually receive for it is referred to as "producers' surplus." Producers' surplus, which is a measure of profits, is measured as the area above the supply curve up to the price of the product (area P_1fa at baseline and area P_2cb with the market adjustment to the regulation). These two areas can be thought of as consumers' net benefit from consuming the commodity and producers' net benefit from producing it, respectively, given the prices and consumption/production rates.

In Figure 9-1, the intersection of the market demand curve D and baseline market supply curve S_1 represents the baseline equilibrium, with baseline equilibrium market price P_1 and equilibrium market quantity Q_1[2]. The higher costs associated with complying with the CWT effluent limitations guidelines and standards shift the supply curve up to S_2. The with-regulation market price is P_2, and the quantity of CWT services produced is Q_2. At the higher market price and lower market quantity resulting from the market adjustment, consumers' surplus has decreased by the area P_2cfP_1. The regulation also affects producers' surplus. The costs of compliance reduce producers' surplus, while the higher market price increases it, everything else held equal. Thus, the social cost of the regulation can be computed by summing

- reductions in consumers' surplus due to increased price and reduced quantity (area P_2cfP_1),
- loss in producers' surplus due to higher costs and lower sales (area befa), and
- increased producers' surplus due to the higher price on remaining production (area P_2ceP_1).

Summing all these areas yields the private social cost of the CWT effluent limitations guidelines and standards, illustrated by area abcf. For the CWT Combined Regulatory

[2] This diagram is correct for perfectly competitive markets. The social cost of the regulation in imperfectly competitive markets is calculated in a similar way. Materials describing how to perform this calculation are elsewhere in the record.

Option, the estimated social cost to producers and consumers (generators or customers in this case) is shown in Table 9-1.

TABLE 9-1. ESTIMATED AGGREGATE COST TO CONSUMERS AND PRODUCERS

Social Cost Component	Change in Value ($\$10^3$ 1997)
Change in Consumer Surplus	-$24,743
Metals Recovery—Medium Cost	-$2,913
Metals Recovery—Low Cost	-$55
Metals Treatment—High Cost	-$555
Metals Treatment—Medium Cost	-$222
Metals Treatment—Low Cost	-$7,933
Oils Recovery—High Cost	-$4,437
Oils Recovery—Medium Cost	-$1,020
Oils Recovery—Low Cost	-$5,654
Oils Treatment	-$944
Organics Treatment—High Cost	-$724
Organics Treatment—Low Cost	-$286
Change in Producer Surplus	$4,654
Sum of Changes in Consumer and Producer Surplus	-$20,089

Overall, the study projects that CWT effluent limitations guidelines and standards will cost consumers and suppliers of CWT services approximately $20.1 million. These costs fall more heavily on the CWT's customers than on the CWT industry. The greater share of the costs of the CWT regulation fall on the customers of the CWTs, who must pay significantly higher prices for their CWT services. The waste recovery and wastewater treatment costs incurred by CWT customers are expected to increase by $24.7 million. As shown above, the CWT regulation, overall, increases the profits of the CWT industry by approximately $4.7 million. Obviously, this does not mean that all CWT facilities, or even the majority of them, experience increased profits. But some CWT facilities do become more profitable as a result of the market adjustments to the CWT effluent limitations guidelines and standards, and those facilities' increased profits outweigh the decreases in profits experienced by others.

Traditionally, social cost computations are based on estimated market adjustments to before-tax compliance costs. Because the computations are based on market adjustments to after-tax compliance costs, this analysis must include an estimate of the burden to government, which is discussed in the following section.

9.2.2 Government's Share of Costs

The tax savings afforded CWT facilities in complying with the regulation represent the cost to governments of the CWT regulation. These costs are transferred from CWTs to other taxpayers through tax deductions and other tax savings. Even though neither the CWT industry or its customers, these costs represent a reallocation of society's resources and thus are part of the opportunity cost of the regulation. Table 9-2 shows the estimated before-tax and after-tax costs of the regulation and government's share of the costs. Government's total share of the costs of the regulation is approximately $12.2 million per year.

To compute the total social cost of this regulation, the Agency summed the costs to producers, consumers, and government, as illustrated in Figure 9-2. Overall, the costs to society of complying with the effluent limitations guidelines and standards include $20.1 million in costs to producers and consumers, plus $12.2 million in costs to government, for a total of approximately $32 million.

TABLE 9-2. GOVERNMENT'S SHARE OF COSTS

Costs	Annualized Costs before Tax Savings ($$10^6$ 1997)	After-Tax Total Annualized Costs ($$10^6$ 1997)	Government Costs ($$10^6$ 1997)
BPT/BAT Costs	$3.56	$2.20	$1.36
PSES Costs	$24.3	$13.4	$10.8
Total Costs	$27.9	$15.6	$12.2

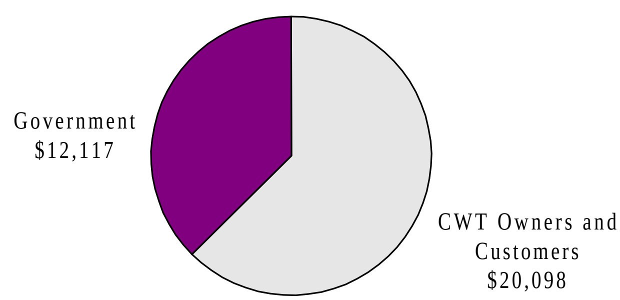


Figure 9-2. Social Cost of the Regulation ($$10^3$ 1997)

The total annual cost to society of the proposed rule exceeds the total annual facility cost of compliance (before-tax savings) by approximately $4 million, or approximately 15.7 percent. This wedge between compliance costs and social costs results from the market adjustments that take place in imperfectly competitive markets for CWT services. Because some CWT facilities operate in monopolistic or oligopolistic markets, they enjoy market power that permits them to increase the market price of their service by more than their costs have increased due to the regulation. This increases the cost of the regulation to society. The market-based analysis represents a short- or intermediate-run analysis of the impacts of the CWT effluent limitations guidelines and standards, as CWT decisions are constrained by existing waste-treatment capacity at each plant an within each market. It represents a high estimate of social costs, and probably overstates the burden of the regulation on CWT customers and understates the burden on CWT owners. Ultimately, the projected increases in waste treatment prices should lead to increases in waste-treatment capacity. Future increases in waste treatment capacity should reduce the projected increases in regional waste treatment prices and increase the quantity of waste treated or recycled at CWT facilities. In the longer run, therefore, CWT customers would be somewhat better off than the model projects, while existing CWT facilities might be somewhat less profitable.

9.3 POLLUTANT REDUCTIONS

The proposed effluent limitations guidelines and standards for the CWT industry would reduce pollutant discharges to surface water by approximately 14.3 million pounds per year of conventional pollutants and 4.1 million pounds per year of toxic and nonconventional pollutants. The following section examines the benefits that are estimated to result from this reduction in discharges. First, EPA describes the methodology to be used. Then, benefits are identified and, to the extent possible, quantified and monetized.

9.4 BENEFITS ASSESSMENT

EPA's proposed effluent guidelines for the CWT industry will reduce discharges of pollutants into several waterways around the country and will also reduce discharges of these substances to a number of POTWs. As a result, the proposed regulation will lead to improvements in both the in-stream water quality and the health of ecological systems in the affected waterbodies. In addition, EPA's evaluation shows that POTWs will experience reducted sludge disposal costs.

This section discusses the assessment and valuation of the benefits of the proposed regulation. First, it presents an overview of the benefits assessment by describing the conceptual framework that guides the analysis and by outlining the steps necessary for applying this framework. Then, it discusses the impacts of environmental changes on human systems and recreational conditions, and it provides monetary estimates associated with these impacts. Finally, the cost savings for POTWs that receive discharges from CWT facilities are estimated. As noted below, the benefits analysis si based on a subset ofthe 145 CWT facilities for which EPA has information. That is, the benefits are not weighted to represent the universe of CWTs. Therefore the benefits presented in this chapter, to the extent that they can be quantified and monetized, cannot be directly compared to the weighted costs presented in earlier chapters.

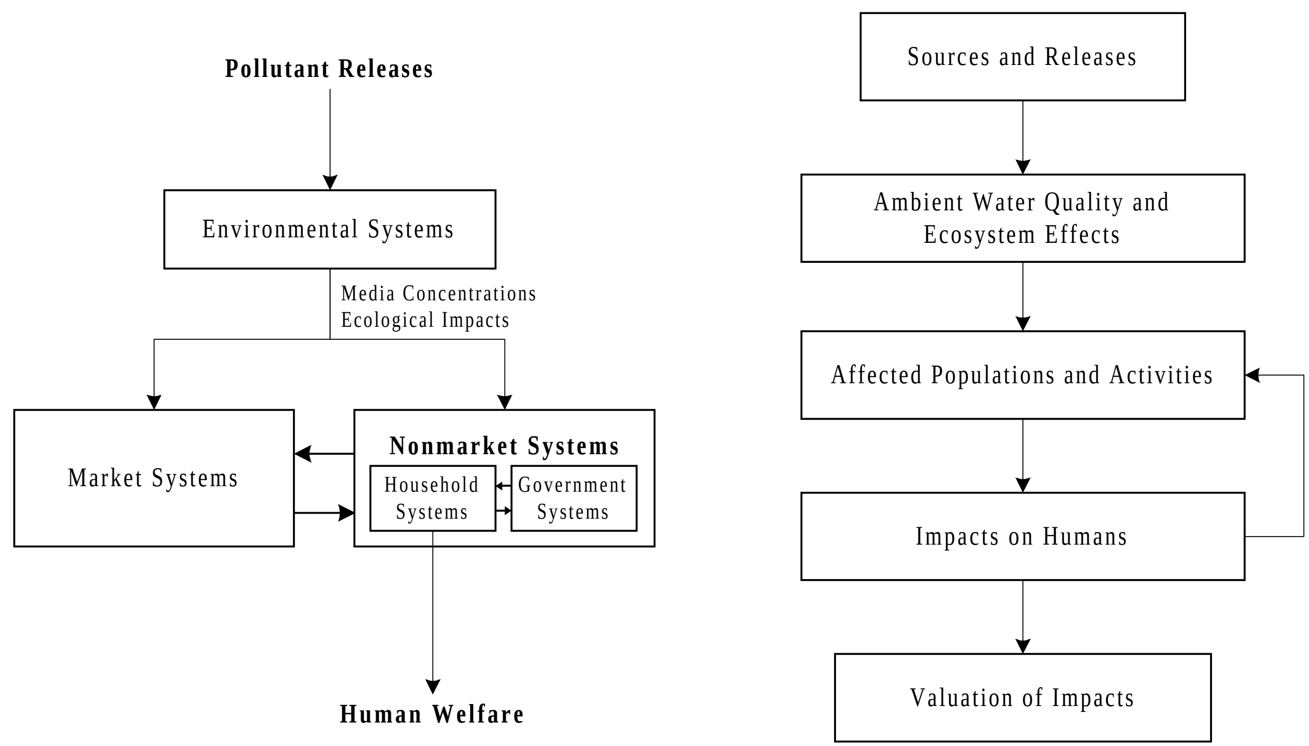
9.4.1 Overview of Benefits Assessment Methodology

Two primary types of benefits are expected to result from the proposed regulation: those resulting from instream water quality improvements and those from cost savings to POTWs. This section develops a conceptual framework for assessing the benefits of surface water quality improvements and provides an overview of the cost-saving benefits to POTWs.

9.4.1.1 A Benefits Analysis Paradigm for Water Quality Improvements

To associate economic values with changes in environmental quality, developing a conceptual framework that incorporates the key interactions between environmental systems and human systems is necessary. Figure 9-3 depicts such a framework. Figure 9-3(a) illustrates the damage pathways (i.e., the routes through which pollutant releases into the

Figure 9-3. Conceptual Framework for Benefits Analysis



a. Damage Pathways: Routes Through Which Pollutant Releases Affect Human Welfare

b. Analytical Process: Steps for Assessing Changes in Human Welfare

environment ultimately affect human welfare). Figure 9-3(b), paralleling the damage pathways, illustrates the analytical framework (i.e., the steps required for evaluating the damages and assessing the benefits of reductions in pollutant releases). Each step of the analytical framework is described below.

Sources and Releases. The first step is to define the affected universe of sources of the harmful pollutants. In total, EPA has information on 145 unweighted CWT facilities that will be subject to the regulation. Twelve of these facilities are direct dischargers, discharging effluent directly into nearby surface water. One hundred and one of these facilities are indirect dischargers, discharging their effluent to POTWs. The remaining 32 facilities dispose of their waste in some way other than discharging it and are considered zero dischargers. Of these 145 facilities, affected stream segments, or "reaches," were identified for 119 facilities. However, water quality impacts have been estimated for only 103 facilities because 16 of the 119 facilities are zero dischargers. Section 3.2.1 describes the pollutants released from these facilities.

Ambient Water Quality and Ecosystem Effects. The second step in the benefits analysis is to distinguish the environmental systems that receive the pollutants and describe how each system assimilates, disperses, and is affected by the substances. In this analysis, the environmental systems of interest are the receiving waterbodies and the aquatic species residing there. Section 3.2.2 describes the 83 waterbodies that receive discharges (directly or indirectly) from the 103 modeled CWT facilities. It then describes the results of water quality modeling for baseline conditions and for each of the regulatory options. Based on facility pollutant loadings and flow rates in the receiving stream, the water quality model generates estimates of pollutant concentrations in the surface water. These concentrations are then compared to EPA-established ambient water quality criteria (AWQC) for aquatic life to provide indicators of potential ecological damage with and without regulation.

Affected Populations and Activities. The third step in the benefits analysis is to determine how human populations are exposed to, and affected by, water-related environmental quality. A fundamental distinction can be made between market and nonmarket effects. As Figure 9-3(a) shows, environmental quality affects human welfare by either through market-based activities or nonmarket activities. On the one hand, individuals interact with markets as both consumers and as suppliers of factors of production (i.e., labor). They are ,therefore, indirectly affected by environmental changes that influence market production. For example, consumers will face higher prices for agricultural products when environmental damages lead to higher costs of production for farmers. On the other hand, individuals interact more directly with the environment in nonmarket contexts, such as most outdoor recreational activities.

Table 9-3 lists many of the potential areas of market and nonmarket damages associated with reductions in water quality. These also represent the primary areas in which benefits may accrue as a result of the proposed rule. Market activities potentially affected by water quality include a range of commercial activities that require proximity to or diversion of surface water. Nonmarket activities include "household production" activities, such as outdoor recreation, as well as government/public goods production, such as large-scale drinking water treatment. Section 9.4.3.2 focuses primarily on fishing activities in the affected reaches and the level of human exposure to contaminated fish. It also discusses the other potentially affected activities.

Impacts on Humans. The fourth step in assessing benefits is to determine the impacts of changes in environmental quality on human systems. The impacts of pollutant discharges can be traced to behavioral changes and other outcomes related to market and nonmarket activities. Table 9-4 provides examples of the major market and nonmarket effects. For example, changes in market production costs, such as costs for commercial fishing, should have observable effects on product prices and quantities sold in markets.

TABLE 9-3. HUMAN SYSTEMS/ACTIVITIES AFFECTED BY SURFACE WATER QUALITY

Mode of Interaction	Affected Activities
Market	
Instream	Commercial fishing, tourism
Near stream	Tourism
Diversionary	Agriculture, manufacturing
Nonmarket/Household	
Instream	Fishing (recreational and subsistence), swimming, boating
Near stream	Residence, hiking, wildlife viewing
Diversionary	Water consumption
Nonuse	Perceptions
Government/Public	
Diversionary	Drinking water treatment and delivery

Nonmarket effects, such as changes in human health or recreational activities, should, in principle, also be observable (or predictable). As shown in Figure 9-3, impacts that alter human behavior may result in different affected populations. For example, increases in the time devoted to recreation may involve increases in angler populations. Other impacts may not be directly observable. For example, nonusers may benefit simply from the knowledge that water quality is improved. This is a real effect of not improved water quality but is not necessarily observable. Section 9.4.2.3 discusses market and nonmarket impacts in more detail with particular emphasis on changes in cancer risks to anglers.

Valuation of Impacts. The final step is to translate market and nonmarket impacts into monetary values that reflect changes in human welfare. The paradigm for relating

TABLE 9-4. IMPACTS ON HUMANS

Changes in Market Behavior and Outcomes
• changes in production costs (i.e., supply)
• changes in demand for and price of residential property
Changes in Nonmarket Outcomes and Behaviors
• changes in the quality and pattern of recreation
• changes in human health risk and outcomes
• nonbehavioral changes (i.e., nonuse-related perceptions)

human welfare to economic valuation is based on the notion of willingness to pay (WTP)—an approach which has been widely accepted in the economics literature. This approach is based on the rather straightforward view that the benefits (value) of a given change (such as improved environmental quality) are equivalent to the maximum amount individuals are willing to pay for the change. Section 9.4.3 discusses WTP-based approaches for valuing reductions in mortality rates and then apply these measures to value the reductions in cancer risk that are estimated to occur as a result of the proposed regulation. It also discusses WTP estimates for valuing recreational fishing days and for valuing improvements in water quality that enhance recreational fishing. Using benefits transfer, EPA applied these values to assess the recreation-based benefits of the proposed regulation.

9.4.1.2 Other Benefits: Cost Savings for POTWs

Another category of benefits expected to result from the proposed regulation is cost savings for POTWs. The fundamental way in which these benefits differ from those discussed previously is that they do not occur as a result of changes in environmental quality. Many of the pollutants from indirect CWT dischargers accumulate in POTW sludges and are, therefore, not released to surface water. Nevertheless, POTWs must dispose of these sludges in ways that comply with existing regulations. When concentrations of specific contaminants in POTW sludges are reduced, POTWs may use or dispose of their sewage sludge less expensively. (The higher the pollutant concentrations in the sludge, the more restrictive are Federal use and disposal requirements and resulting disposal costs.) Although these cost-saving benefits are not directly incorporated in the paradigm presented in Figure 9-3 and discussed above, they will nonetheless have a positive effect on social welfare. The procedures for estimating these cost savings and the results of this part of the analysis are presented in Section 9.4.4.2.

9.4.2 Impacts of Proposed CWT Effluent Limitations Guidelines and Standards

EPA expects that the proposed regulation, if adopted, will improve water quality in several waterbodies across the United States by reducing pollutant loadings and instream concentrations of over 100 pollutants. The following sections discusses the water quality impacts of the proposed regulation in greater detail below.

9.4.2.1 Impacts on Ambient Water Quality and Related Ecosystems

The proposed regulation will reduce the in-stream concentrations of over 100 pollutants in the waterways affected by CWT facility effluents. In-stream concentrations were modeled for each of these pollutants under both baseline and with-regulation scenarios. The details of this modeling process are provided in the *Environmental Assessment of Proposed Effluent Guidelines for the Centralized Waste Treatment Industry* (EPA, 1998). This assessment bases its estimation of these concentrations on estimates of pollutant loadings in the affected waterways and on estimates of the stream flow in these waterways.[3]

[3]Three stream flow conditions were analyzed (1Q10 low flow, 7Q10 low flow, and harmonic mean flow); the first two were used to assess aquatic life impacts and the third was used to assess human health impacts.

Elevated in-stream concentrations of these pollutants have the potential to adversely affect ecological systems in a variety of ways. Aquatic organisms, in particular, will face higher risks as a result of the degradation of the quality of their habitats. For this analysis, EPA did not conduct a full ecological risk assessment of these impacts for the CWT reaches. However, the assessment does examine the consequences for aquatic life by comparing in-stream concentrations of each pollutant with EPA's AWQC for the protection of aquatic life.

EPA has established water quality criteria for many pollutants for the protection of freshwater aquatic life. These criteria include both acute and chronic criteria. The acute value represents a maximum allowable 1-hour average concentration of a pollutant at any time and can be related to acute toxic effects on aquatic life. The chronic value represents the average allowable concentration of a toxic pollutant over a 4-day period. If these levels are not exceeded more than once every 3 years, a diverse array of aquatic organisms and their uses should not be unacceptably affected. For pollutants that do not have specific AWQC, the study estimates specific toxicity values using various techniques or have been taken from the published literature.

Table 9-5 reports the number of reaches with estimated exceedances of the AWQC for aquatic life based on an analysis of 83 potentially affected CWT reaches. Under baseline conditions, a total of three reaches will exceed the AWQC for acute aquatic life, and a total of three reaches will exceed the AWQC for chronic aquatic life. As noted in the footnote in Table 9-5, the combined baseline total may be less than the sum of the subcategory exceedances because some reaches receive discharges from more than one subcategory. Under the regulatory options, reductions in exceedances for acute and chronic aquatic life will occur for the three subcategories. Under Oils Options 8 and 9, the number of exceedances for acute aquatic life will drop from one to zero, while the number of exceedances for chronic aquatic life will remain unaffected. Metals Option 4 will reduce

TABLE 9-5. EXCEEDANCES OF AMBIENT WATER QUALITY CRITERIA FOR AQUATIC LIFE

	Number of Reaches with AWQC Exceedances for Aquatic Life		
	Acute Effects	**Chronic Effects**	**Both Acute and Chronic Effects**
Baseline			
Metals	2	2	4
Oils	1	2	3
Organics	0	1	1
Combined baseline[a]	3	3	6
With Regulation			
Metals Option 4	1	2	3
Oils Option 8	0	2	2
Oils Option 9	0	2	2
Organics Option 4	0	0	0
Combined Regulatory Option			5

[a] Some reaches receive discharges from more than one subcategory; therefore, the combined baseline total may be less than the total of the subcategories.

exceedances for acute aquatic life to one, while chronic aquatic life exceedances remain unchanged under this option. Organics Option 4 eliminates all exceedances.

Table 9-5 also indicates that there will be five AWQC exceedances for aquatic life under the Combined Regulatory Option. The facilities included in this combined option are:

- Combined Regulatory Option = Metals Option 4 (direct and indirect dischargers) + Oils Option 8 (indirect dischargers) + Oils Option 9 (direct dischargers) + Organics Option 4 (direct and indirect dischargers)

Two important caveats to these results deserve attention. First, background concentrations of each pollutant were assumed to be zero. Consequently, EPA evaluated the impacts of CWT facility discharges. Second, the analysis did not consider pollutant fate processes such as adsorption to sediments and volatilization, which would lower in-stream concentrations. The net impact of these two simplifying assumptions is unclear—the former leads to underestimates of in-stream concentrations, whereas the latter leads to overestimates. The impact on *changes* in the number of exceedances as a result of the proposed regulation is even less clear. Nevertheless, the results do indicate potentially important improvements in the aquatic habitats of the CWT reaches.

The ways in which these improvements in ecological systems will lead to improvements in human welfare will ultimately depend on how humans interact with and perceive the ecological systems. The next section discusses these and other effects on human systems.

9.4.2.2 Affected Populations and Activities

As shown in Table 9-3, a wide variety of human activities are potentially affected by changes in water quality due to CWT effluents; however, there is inadequate information for quantifying many of these effects. As a result, this section focuses on the measurement of recreational and subsistence fishing populations, for which there is adequate data.

Recreational and Subsistence Fishing: Estimation of Fishing Populations at the Affected Reaches. To develop an estimate of the number of individuals exposed to the regulated pollutants through the fish consumption pathway, EPA assumed that the exposed population consists of both the anglers who fish the CWT reaches and their families. The following discussion reviews the step-by-step approach used to estimate the number of affected individuals in recreational and subsistence fishing households and summarizes the results of the analysis.

Step 1: Designate a 30-Mile Buffer Zone Around Each Affected Reach. The first step in estimating the total exposed population for the fish consumption pathway was to isolate the area surrounding each reach where these individuals are most likely to reside. This area can be thought of as the extent of the "market" for the reach. EPA assumed that these individuals will primarily be located within 30 miles of each reach. Evidence on recreational fishing behavior for the nation as a whole indicates that between 52 and 68 percent of trips to the freshwater fishing sites most often used by individual anglers are within 30 miles of their homes (DOI, 1993). Because the affected reaches are located primarily in urban areas, the average distance traveled to these reaches is probably below the national average.
Using Arcview Geographic Information System (GIS) software (ESRI, 1995), EPA isolated a 30-mile buffer-zone around each reach and estimated the total U.S. land area within the zone. Because of variations in the length of each reach and the proximity to large bodies of water, these buffer zones vary substantially, from 900 to 6,700 square miles. The average area of a buffer zone is 3,400 square miles.

Step 2: Estimate the Population in Each Buffer Zone. To estimate the 1996 population in the buffer zone, EPA overlaid GIS software onto U.S. Census data. This resulted in population estimates ranging from 81,000 to 14 million. The Agency determined the average population of a buffer zone to be 2.1 million.

Step 3: Estimate the Total Number of Anglers in the Buffer Zone. As mentioned earlier, EPA assumed that the relevant exposed population is made up of the fishermen who fish the CWT reaches and their families. To calculate the number of anglers who live in each buffer zone, the Agency assumed that the ratio of anglers to total population was the same for the buffer zone as it was for the state in which the reach was located. Using data from *The 1996 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation* (DOI, 1997), EPA estimated the percentage of anglers in each state and then applied these values to the affected reaches in each state. EPA arrived at estimates for the total number of anglers in each buffer zone that range from 21,000 to 1.9 million. The average number of anglers in the buffer zones is 300,000.

Step 4: Estimate the Number of Anglers in the Buffer Zone Who Fish the Reach. The next step was to estimate the number of anglers who fish specifically at the CWT reaches. To calculate this number, the Agency assumed that anglers within each buffer zone were evenly distributed to all reach miles within the zone.[4] Using GIS, EPA first estimated the length of each CWT reach as a percentage of total reach miles within their respective buffer zones. These values range from 0.11 percent to 4.5 percent. To calculate the number of anglers who fish the CWT reach, the Agency then multiplied the total number of anglers within the buffer zone by this ratio. Using this methodology, the number of fishermen who fish each reach was estimated to range from 85 to 25,000. The average number of fishermen who fish on a particular reach was computed to be 3,500.

Step 5: Adjust Fishing Population Estimates for Existence of Fish Advisories at the CWT Reaches. A number of the CWT reaches currently have fish consumption health advisories in place. Although these advisories are generally due to pollutants such as dioxin and PCBs, which are not affected by this proposed regulation, it is reasonable to assume that some proportion of anglers would adhere to the advisories and not fish the reach in question.

[4]Clearly anglers may visit different reaches on different occasions; however, for purposes of the health risk analysis, the aggregate health impact of one angler visiting a site all of the time is equivalent to two anglers visiting the site half the time (or three anglers visiting the site a third of the time, etc.). Therefore, rather than assuming that fishing *trips* are evenly distributed to each reach mile over the course of a year, EPA simply assumed that the *anglers* themselves are evenly distributed to each reach mile.

Past studies suggest that fishermen have a high, although not complete, level of awareness of fish advisories. For example, Fiore et al. (1989) found that 72 percent of fishermen were familiar with fishing advisories. Connelly, Knuth, and Bisogni (1992) and Connelly and Knuth (1993) also found high rates of awareness (83 to 85 percent) in Great Lakes and New York sport fisheries. For Maine sport fisheries, MacDonald and Boyle (1997) found 76 percent and 33 percent awareness rates, respectively, for residents and nonresidents. Despite this level of awareness, other evidence suggests individuals do not necessarily fully adjust their behavior by no longer fishing at the site or no longer consuming the fish caught at the site (May and Burger, 1996; MacDonald and Boyle, 1997; Velicer and Knuth, 1994; Cable and Udd, 1990). For the purposes of this analysis, the Agency assumed a 20 percent decrease in fishing activity for reaches under fish advisory. Section 9.4.2.3 discusses in more detail some of the uncertainties associated with this assumption.

Twenty-two of the reaches in the analysis currently have fish advisories. To adjust for the decline in fishing in these reaches, the analysis reduced the estimated total number of recreational and subsistence fishermen by 20 percent at these reaches.

Step 6: Estimate the Number of Subsistence and Recreational Fishermen in Each Reach. The above calculations do not distinguish between recreational and subsistence fishing populations. However, estimating these populations separately is important because fish consumption rates differ substantially between recreational and subsistence anglers. The precise magnitude of subsistence fishing in individual states or the country as a whole is not known. For the purpose of this analysis, EPA assumed that 5 percent of all anglers are subsistence fishermen.

Step 7: Estimate Household Exposure for the Fish Consumption Analysis. Finally, the analysis requires an estimate of the total population exposed to CWT pollutants by consuming fish. The Agency assumed that this population includes not only the anglers themselves but also other members of their households. Therefore, for each reach, the estimated number of recreational and subsistence fishermen was multiplied by 2.65, the size of the average U.S. household in 1996 (U.S. Department of Commerce, 1997), to estimate the total exposed population.

The average exposed household population per reach is 8,600. The average exposed household population for subsistence and recreational fishermen and their families is 400 and 8,200, respectively. The total exposed household population for all affected reaches is 694,000. Of this total, 659,000 are from recreational fishing households, and 35,000 are from subsistence fishing households. Section 9.4.2.3 reports the exposed household populations for each reach, along with the discussion of cancer risks.

9.4.2.3 Impacts on Humans

As discussed earlier in this section, water quality in the affected reaches has the potential to affect a wide range of both market and nonmarket activities. This report now focuses on the ways in which these activities are affected and the projected outcomes of improvements in water quality. Based on these impacts, EPA estimates in Section 9.4.3 some of the human welfare effects of the proposed regulation.

The impacts that are most readily quantified are nonmarket in nature. They are the human health impacts related to fish consumption from recreational and subsistence fishing. This section first discusses the quantitative assessment of health impacts, focusing primarily on cancer risks. It then discusses the limitations and uncertainties inherent in these assessments and assesses qualitatively the other potential impacts of the proposed regulation.

Characterization of Human Health Effects. Fish consumption is the primary route through which individuals are likely to be exposed to the pollutants in the effluents of CWT facilities. Over 100 hazardous substances have been detected in these effluents, and they are associated with a wide range of health effects. These effects can be divided into cancer effects, noncancer effects, and lead-related health effects, each of which is discussed below.

Cancer Effects. Table 9-6 provides a list of the potentially carcinogenic substances that have been detected and information about the weight of evidence (WOE), cancer potency factor, and target organ of each substance. EPA has established a WOE classification system for suspected carcinogens. Carcinogens designated as Class A, which are considered known carcinogens, are the only chemicals that can be associated with specific types of cancer. This classification is based primarily on evidence from human data. As indicated in Table 9-6, arsenic, benzene, and vinyl chloride are the only CWT pollutants that are known carcinogens. Those designated as Class B are considered probable carcinogens, and those designated as Class C are considered possible carcinogens. Cancer potency factors for Class B and Class C carcinogens are based primarily on experimental animal studies and, therefore, are subject to more uncertainty.[5] Furthermore, they cannot be associated with specific types of cancer. Chemicals are designated as Class D when there is either no data or inadequate evidence of the carcinogenicity on humans or animals.

Noncancer Effects. Evidence suggests that several of the pollutants in CWT facility effluents can lead to noncancer health effects. These noncancer systemic effects include neurological, immunological, reproductive, developmental, circulatory, and respiratory effects. Table 9-7 lists the chemicals and reference concentrations and briefly describes the target organs and/or health effects associated with each pollutant. Assessing noncancer risk can be considerably more complex because the health endpoints are typically less clearly

[5]The potency factor is used to measure the dose-response relationship between each substance and the cancer health effect. Also known as the unit risk factor (URF), it is specifically defined as the probability of a response (cancer) per unit intake of a chemical over a lifetime. For the oral ingestion of these pollutants, the unit intake is defined as one milligram per day per kilogram of body mass. A lifetime is assumed to be 70 years.

TABLE 9-6. CHARACTERIZATION OF CARCINOGENIC SUBSTANCES IN CWT EFFLUENT

CAS Number	Carcinogen	Weight-of-Evidence Classification[a]	Cancer Potency Factor
7440382	Arsenic	A	1.75
50328	Benzo(a)pyrene	B2	7.3
56235	Tetrachloromethane	B2	0.13
56553	Benzo(a)anthracene	B2	1.06
67663	Trichloromethane (Chloroform)	B2	0.0061
71432	Benzene	A	0.029
75014	Vinyl Chloride	A	1.9
75092	Methylene chloride	B2	0.0075
75252	Tribromomethane	B2	0.0079
75354	1,1-dichloroethene	C	0.6
79005	1,1,2-trichloroethane	C	0.057
86748	Carbazole	B2	0.02
87865	Pentachlorophenol	B2	0.12
106467	1,4-dichlorobenzene	C	0.024
106934	1,2-dibromoethane	B2	85
107062	1,2-dichloroethane	B2	0.091
117817	Bis(2-ethylhexyl) phthalate	B2	0.014
124481	Dibromochloromethane	C	0.084
127184	Tetrachlorethene	B2	0.051
205992	Benzo(b)fluoranthene	B2	1.02
207089	Benzo(k)fluoranthene	B2	0.48
218019	Chrysene	B2	0.032
630206	1,1,1,2-tetrachloroethane	C	0.026

[a]Weight-of-evidence classification codes:
- A–Human carcinogen
- B1–Probable human carcinogen (limited human data)
- B2–Probable human carcinogen (animal data only)
- C–Possible human data
- D–Not classifiable as to human carcinogenicity

Source: U.S. Environmental Protection Agency.

TABLE 9-7. CHARACTERIZATION OF NONCANCER EFFECTS FROM SUBSTANCES IN CWT EFFLUENT

CAS Number	Pollutant	Reference Dose (RfD) (mg/kg-day)	Target Organ/System	Effect
630206	1,1,1,2-tetrachloroethane	0.03	Kidney, liver	Mineralization of the kidneys in males, hepatic clear cell change in females
71556	1,1,1-trichloroethane	0.09	Not available	Not available
79005	1,1,2-trichloroethane	0.004	Hematological	Clinical serum chemistry
75354	1,1-dichloroethene	0.009	Liver	Hepatic lesions
96184	1,2,3-trichloropropane	0.006	Hematological	Alterations in clinical chemistry and reduction in red cell mass
120821	1,2,4-trichlorobenzene	0.01	Adrenal	Increased adrenal weights; vacuolation of zona fasciculata in the cortex
95501	1,2-dichlorobenzene	0.09	No effects	No adverse effects observed
58902	2,3,4,6-tetrachlorophenol	0.03	Liver	Increased liver weight and centrilobular hypertrophy
95954	2,4,5-trichlorophenol	0.1	Kidney, liver	Liver and kidney pathology
105679	2,4-dimethylphenol	0.02	Hematological, neurological	Clinical signs (lethargy, prostration, and ataxia) and hematological changes
67641	2-propanone	0.1	Kidney, liver	Increased liver and kidney weights and nephrotoxicity
59507	4-chloro-3-methylphenol	2	Body weight	Decreased weight gain
108101	4-methyl-2-pentanone	0.08	Liver, kidney, neurotoxicity	Increased absolute and relative weight of liver; increased relative and absolute weight of kidney and increased urinary protein; lethargy

(continued)

TABLE 9-7. CHARACTERIZATION OF NONCANCER EFFECTS FROM SUBSTANCES IN CWT EFFLUENT (CONTINUED)

CAS Number	Pollutant	Reference Dose (RfD) (mg/kg-day)	Target Organ/System	Effect
83329	Acenapthene	0.06	Liver	Hepatotoxicity
98862	Acetophenone	0.1	General	General toxicity
120127	Anthracene	0.3	No effects	No observed effects
7440360	Antimony	0.0004	Hematological	Blood glucose and cholesterol, longevity
7440382	Arsenic	0.0003	Skin	Hyperpigmentation, keratosis and possible vascular complications
7440393	Barium	0.07	Cardiovascular, kidney	Hypertension in humans; increased kidney weight in rats
65850	Benzoic acid	4	No effects	No adverse effects observed
100516	Benzyl alcohol	0.3	GI	Epithelial hyperplasia of the forestomach
92524	Biphenyl	0.05	Kidney	Kidney damage
117817	bis(2-ethylhexyl) phthalate	0.02	Liver	Increased relative liver weight
7440428	Boron	0.09	Reproductive	Testicular atrophy, spermatogenic arrest
78933	Butanone	0.6	Developmental	Decreased fetal birth weight
85687	Butyl benzyl phthalate	0.2	Liver	Significantly increased liver-to-body weight and liver-to-brain weight ratios
7440439	Cadmium	0.0005	Kidney	Significant proteinuria
75150	Carbon disulfide	0.1	Developmental	Fetal toxicity/malformations

(continued)

TABLE 9-7. CHARACTERIZATION OF NONCANCER EFFECTS FROM SUBSTANCES IN CWT EFFLUENT (CONTINUED)

CAS Number	Pollutant	Reference Dose (RfD) (mg/kg-day)	Target Organ/System	Effect
108907	Chlorobenzene	0.02	Liver	Histopathologic changes in liver
67663	Chloroform	0.01	Liver	Fatty cyst formation in liver
7440473	Chromium	1	Not available	Not available
84662	Diethyl phthalate	0.8	Body weight, organ weight	Decreased growth rate, food consumption and altered organ weights
84742	di-n-butyl phthalate	0.1	Death	Increased mortality
117840	di-n-octyl phthalate	0.02	Kidney, liver	Increased kidney weight; Increased liver weight; increased SGOT and SGPT activity
122394	Diphenylamine	0.025	Body weight, kidney, liver	Decreased body weight gain, and increased liver and kidney weights
100414	Ethylbenzene	0.1	Kidney, liver	Liver and kidney toxicity
206440	Fluoranthene	0.04	Hematological, kidney, liver	Nephropathy, increased liver weights, hematological alterations and clinical effects
86737	Fluorene	0.04	Hematological	Decreased RBC, packed cell volume and hemoglobin
7439965	Manganese	0.005	Neurotoxicity	CNS effects
7439976	Mercury	0.0003	Not available	Not available
75092	Methylene chloride	0.06	Liver	Liver toxicity
7439987	Molybdenum	0.005	Metabolic	Increased uric acid
108383	m-xylene	2	Body weight, neuro	Decreased body weight, hyperactivity

(continued)

TABLE 9-7. CHARACTERIZATION OF NONCANCER EFFECTS FROM SUBSTANCES IN CWT EFFLUENT (CONTINUED)

CAS Number	Pollutant	Reference Dose (RfD) (mg/kg-day)	Target Organ/System	Effect
91203	Naphthalene	0.04	Not available	Not available
7440020	Nickel	0.02	Body weight, organ weight	Decreased body weight and organ weights
136777612	o+p xylene	2	Not available	Not available
95487	o-cresol	0.05	Body weight, neurological	Decreased body weights and neurotoxicity
106445	p-cresol	0.05	Neurological, respiratory	Hypoactivity; respiratory distress; maternal death
87865	Pentachlorophenol	0.03	Kidney, liver	Liver and kidney pathology
108952	Phenol	0.6	Developmental	Reduced fetal body weight in rats
7723140	Phosphorous	0.00002	Reproductive	Parturition mortality; forelimb hair loss
129000	Pyrene	0.03	Kidney	Kidney effects (renal tubular pathology, decreased kidney weights)
110861	Pyridine	0.001	Liver	Increased liver weight
7782492	Selenium	0.005	Respiratory	Clinical selenosis
7440224	Silver	0.005	Skin	Argyria
7440246	Strontium	0.6	Bone	Rachitic bone
100425	Styrene	0.2	Hematological, liver	Red blood cell and liver effects
127184	Tetrachloroethene	0.01	Liver	Hepatotoxicity in mice, weight gain in rats
56235	Tetrachloromethane	0.0007	Liver	Liver lesions

(continued)

TABLE 9-7. CHARACTERIZATION OF NONCANCER EFFECTS FROM SUBSTANCES IN CWT EFFLUENT (CONTINUED)

CAS Number	Pollutant	Reference Dose (RfD) (mg/kg-day)	Target Organ/System	Effect
7440315	Tin	0.6	Not available	Not available
108883	Toluene	0.2	Kidney, liver	Changes in liver and kidney weights
57125	Total cyanide	0.02	Body weight, neurological, thyroid	Weight loss, thyroid effects and myelin degeneration
156605	trans-1,2-dichloroethene	0.02	Hematological	Increased serum alkaline phosphatase in male mice
79016	Trichloroethene	0.2000	Developmental	Not available
7440622	Vanadium	0.007	No effects	No observed adverse effects
75014	Vinyl chloride	0.00002	Liver	Not available
7440666	Zinc	0.3	Hematological	47 percent decrease in erythrocyte superoxide dismutase (ESOD) concentration in adult females after 10 weeks of zinc exposure

Source: U.S. Environmental Protection Agency.

defined and much broader in scope. Furthermore, in contrast to cancer risk, noncancer risk assessment is based on a threshold concept. At small levels of exposure, the body may detoxify or compensate for exposures to pollutants, and no adverse health effects are observed. However, as the level of exposure increases, the body becomes unable to accommodate the pollutant, and eventually adverse health effects are observed.

Thresholds are determined by the level of exposure at which the adverse health effects could occur. The lowest dose level at which the critical adverse effect is observed is called the Lowest Observed Adverse Effect Level (LOAEL). The highest dose at which adverse effects are not observed is the No Observed Adverse Effects Level (NOAEL). The NOAEL is usually used to estimate a protective threshold level, while the LOAEL is used to indicate the levels of exposure at which adverse effects are likely. Reference doses (RfD) are derived from the NOAEL and are considered protective thresholds for ingestion. RfD can be defined as an estimate of daily exposure to a chemical (measured as mg/kg-day) that is likely to be without deleterious effects during a lifetime. To calculate the RfD, the NOAEL for a chosen critical effect is divided by the product of a risk factor (typically a factor of 10) and a modifying factor, which account for extrapolation from available data to the conditions under which normal exposures would occur. Table 9-7 reports the RfDs for each chemical.

Lead-Related Health Effects. Lead is both highly persistent in the environment and highly toxic for humans and ecosystems. It is associated with a broad range of adverse human health effects, including hypertension and heart disease in adults and developmental impairments for children. Table 9-8 lists a more complete accounting of lead-related health effects. In contrast to other noncarcinogens, many of the specific health effects and risks from lead exposure can be quantified. Rather than relying on an RfD threshold model, the magnitude of these health effects can be estimated using dose-response models similar to those that are used to estimate cancer risks.

TABLE 9-8. QUANTIFIED AND UNQUANTIFIED HEALTH EFFECTS OF LEAD

Population Group	Quantified Health Effect	Unquantified Health Effect
Adult male	For mean in specified age ranges: Hypertension; Nonfatal coronary heart disease; Nonfatal strokes; Mortality	Quantified health effects of men in other age ranges; Other cardiovascular diseases; Neurobehavioral function
Adult female	For women in specified age ranges: Nonfatal coronary heart disease; Nonfatal stroke; Mortality	Quantified health effects of women in other age ranges; Other cardiovascular diseases; Reproductive effects; Neurobehavioral function
Children	IQ loss effect on lifetime earnings; IQ loss on special educational needs; Neonatal mortality due to low birth weight caused by maternal exposure to lead	Fetal effects from maternal exposure (including diminished IQ); Other neurobehavioral and physiological effects; Delinquent and antisocial behavior

Source: U.S. Environmental Protection Agency. October 1997a. *The Benefits and Costs of the Clean Air Act, 1970 to 1990*. Research Triangle Park, NC: Office of Air Quality Planning and Standards.

Exceedances of Ambient Water Quality Criteria for Human Health. In addition to the previously described ambient water quality criteria for aquatic life, EPA has also established pollutant-specific criteria for the protection of human health. These criteria identify maximum allowable in-stream pollutant concentrations to protect human health through two exposure routes: (1) pollutant ingestion through consumption of contaminated aquatic organisms and (2) pollutant ingestion through both consumption of contaminated aquatic organisms and water. Human health is assumed not to be protected if in-stream concentrations are associated with lifetime cancer risks exceeding 10^{-6} or with doses exceeding the RfDs for noncancer toxic effects. A more detailed description of the models underlying these criteria is provided in the *Environmental Assessment of Proposed Effluent Guidelines for the Centralized Waste Treatment Industry* (EPA, 1998).

Table 9-9 reports the number of reaches with exceedances of the AWQC for human health based on the analysis of 83 potentially affected CWT reaches. Under baseline conditions, 17 reaches will exceed the AWQC for the consumption of contaminated aquatic organisms, and 19 reaches will have exceedances for the consumption of contaminated aquatic organisms and water. Most of these baseline exceedances can be attributed to the oils subcategory. Under the proposed regulatory options, the number of metals exceedances will remain unchanged, while the number of exceedances for the oils and organics subcategories will decrease. Both Oils Option 8 and Oils Option 9 will have 11 exceedances of the AWQC for the consumption of contaminated aquatic organisms, and they will have nine exceedances of the AWQC for the consumption of contaminated aquatic organisms and water. Total exceedances for Organics Option 4 will drop from five to one as a result of the regulation.

These AWQC exceedances described in Table 9-9 provide rough indicators of potential threats to human health. These indicators are used in Section 9.4.3.2 to assess the recreation-based values of the proposed regulation. More detailed estimates of human health risks from consumption of contaminated fish are first discussed in the following sections.

Health Risks from Fish Consumption. The information obtained on chemicals discussed in the two previous sections that are thought to pose either cancer or noncancer human health risks can be used to estimate the health risks from fish consumption. Fish

TABLE 9-9. NUMBER OF REACHES WITH AWQC EXCEEDANCES FOR HUMAN HEALTH

	Consumption of Contaminated Aquatic Organisms	Consumption of Contaminated Aquatic Organisms and Water	Total Exceedances for Human Health
Baseline			
Metals	2	3	5
Oils	15	15	30
Organics	0	5	5
Combined Baseline[a]	17	19	36
With Regulation			
Metals Option 4	2	3	5
Oils Option 8	11	9	20
Oils Option 9	11	9	20
Organics Option 4	0	1	1
Combined Regulatory Option			26

[a] Some reaches receive discharges from more than one subcategory; therefore, the combined baseline total may be less than the total of the subcategories.

consumption at both baseline levels of contamination and at post-regulatory levels is considered when approximating the levels of exposure to each chemical at each affected reach for “typical” individuals (i.e., the recreational and subsistence anglers and the members of their households that use the affected reaches). To estimate cancer risks, EPA combined the previously described information about the size of these exposed populations with information about average individual levels of exposure at each affected reach. The Agency was then able to estimate the number of cancer cases (i.e., cancer incidence) attributable to CWT facility pollutants.

By contrast, estimates of noncancer health effects are inherently more limited. Analysts can observe whether the estimated individual levels of exposure to each chemical exceed their respective safety thresholds (RfDs); however, without dose-response information, they cannot estimate the incidence of noncancer health effects in the exposed population. In other words, the noncancer assessment can indicate whether exposure levels are likely to cause adverse health effects, but it cannot provide an estimate of the magnitude of these health effects.

Cancer Risks. As Figure 9-4 illustrates, several steps are required to estimate the annual cancer incidence that is expected to result from consuming fish from the affected reaches. The *Environmental Assessment of Proposed Effluent Guidelines for the Centralized Waste Treatment Industry* provides methodological details for accomplishing the first three steps in this figure (EPA, 1998). Below, these three steps, as well as a final step for estimating annual cancer incidence are summarized.

The first step is to estimate in-stream concentrations for each of the carcinogenic pollutants listed in Table 9-6. This step is accomplished by combining information on pollutant loadings with specific characteristics of the receiving streams.[6] Most importantly, EPA assumed that in-waterway pollutant concentrations are inversely proportional to waterway flow downstream of the discharge. EPA considers the harmonic mean waterway flow (HMF) to be the appropriate measure for assessing human health effects. EPA assumed that background concentrations of each of these chemicals are zero. In other words, EPA assumed that CWT effluents were the only source of these chemicals in the affected reaches.

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[6]For indirect dischargers, the initial calculation of pollutant loadings must consider not only the concentrations in the effluent from the CWT facilities, but also the removal efficiencies for each pollutant at the receiving POTW as well.

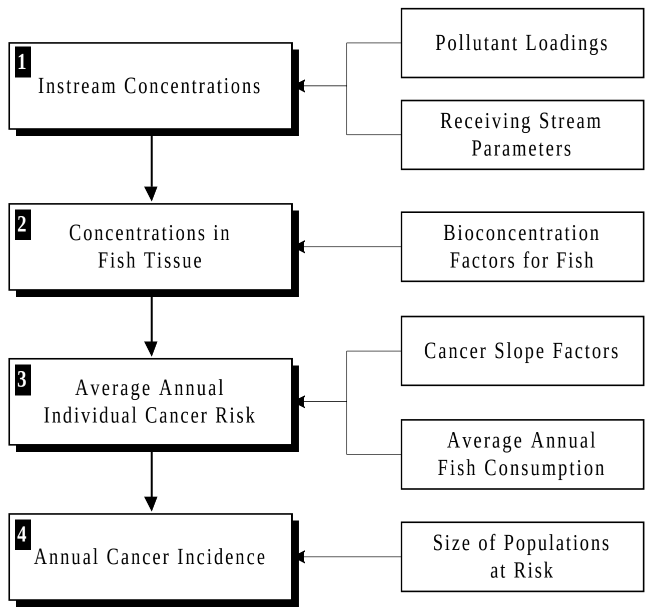

Figure 9-4. Steps for Assessing Annual Cancer Incidence from Fish Consumption

The second step is to calculate concentrations of each of the pollutants in the tissue of fish species residing in the affected waterways. This step is accomplished by combining information from the first step (in-stream concentrations) with an assumed rate of uptake by the fish species (i.e., bioconcentration factor).

The third step is to calculate the average annual individual cancer risk for the two categories of exposed populations. recreational fishing households consume 30 grams of fish per day over a 30-year period and 6.5 grams per day over a 40-year period. This level of consumption translates to an average of approximately 6.05 kilograms per year. The analysis assumes that people in subsistence fishing households consume 140 grams per day of fish over 70 years of exposure, which translates to an average of approximately 51.1 kilograms per year. Using the cancer potency factors listed in Table 9-6 for each carcinogen, EPA estimated the lifetime individual cancer risks for recreational and subsistence fishing households. For each affected reach and individual, this value can be interpreted as the individual's *incremental* risk of developing cancer that would result from consuming an average annual dose of fish from the affected reach over the course of a 70-year lifespan.

Table 9-10 provides the *lifetime* individual cancer risks for individuals in recreational and subsistence households. As expected, risks for subsistence households are higher than those for recreational households by nearly one order of magnitude. These risks are distinguished for direct and indirect dischargers, as well. The mean individual lifetime cancer risk for populations affected by direct dischargers is greatest under the metals subcategory (3×10^{-6} for recreational fishermen and 2.5×10^{-5} for subsistence fishermen), while the oils subcategory has the greatest mean for those populations affected by indirect dischargers (4×10^{-5} for recreational fishermen and 3×10^{-4} for subsistence fishermen).

The next step is to calculate the *annual* cancer incidence for the affected reaches at baseline levels and at the proposed post-regulatory levels. The analysis estimates annual individual cancer risks by dividing these lifetime risks by 70—the assumed number of years in a lifetime. Annual cancer incidence is then computed by multiplying (1) the individual annual cancer risk for each population subgroup (sorted by reach and activity—recreational or subsistence) by (2) the size of each population subgroup. Section 9.4.2.2 details the procedures used to estimate each of the population subgroups. Table 9-11 reports results for baseline cancer incidence. This analysis estimates total baseline annual cancer incidence for fish consumption from the affected reaches is approximately 0.95 cases per year. Indirect dischargers account for approximately 99 percent of these cases and direct dischargers account for the remaining one percent.

TABLE 9-10. CANCER RISKS FOR ANGLERS AND THEIR FAMILIES[a]

		Recreational			Subsistence		
			Range of Individual Lifetime Cancer Risks			Range of Individual Lifetime Cancer Risks	
	Number of Reaches[b]	Mean Individual Lifetime Cancer Risk	Minimum	Maximum	Mean Individual Lifetime Cancer Risk	Minimum	Maximum
Direct Dischargers							
Subcategory							
Metals	2	2.9×10^{-6}	5.1×10^{-9}	1.7×10^{-5}	2.5×10^{-5}	4.3×10^{-8}	1.5×10^{-4}
Oils	1	3.8×10^{-10}	3.8×10^{-10}	3.8×10^{-10}	3.2×10^{-9}	3.2×10^{-9}	3.2×10^{-9}
Organics	3	3.5×10^{-8}	1.4×10^{-12}	6.0×10^{-7}	3.0×10^{-7}	1.2×10^{-11}	5.0×10^{-6}
Indirect Dischargers							
Subcategory							
Metals	26	1.5×10^{-7}	3.6×10^{-11}	3.0×10^{-6}	1.3×10^{-6}	3.0×10^{-10}	2.5×10^{-5}
Oils	50	3.8×10^{-5}	9.7×10^{-14}	7.9×10^{-4}	3.2×10^{-4}	8.2×10^{-13}	6.7×10^{-3}
Organics	15	6.6×10^{-8}	1.4×10^{-12}	6.0×10^{-7}	5.6×10^{-7}	1.2×10^{-11}	5.0×10^{-6}

[a] Only reaches with positive estimated individual lifetime cancer risk values are included in this table.
[b] Reaches receiving discharges from more than one subcategory are treated as separate reaches in this table.

TABLE 9-11. BASELINE ANNUAL CANCER INCIDENCE (FISH CONSUMPTION BY ANGLERS)

	Direct Dischargers	Indirect Dischargers	Total
Metals	0.006	0.001	0.008
Oils	0.000	0.942	0.942
Organics	0.000	0.000	0.000
Combined	0.006	0.944	0.950

This assessment repeated these four steps for each of the proposed regulatory options by reestimated in-stream concentrations for each option based on their respective pollutant loadings and annual cancer incidence at each reach. Table 9-12 reports the reductions in annual cancer incidence for each subcategory (metals, oils, and organics). This assessment showed that the regulatory options for the oils subcategory accounted for the largest reductions in cancer incidence. All of the regulatory options combined will reduce the total cancer incidence at all affected reaches by approximately 68 percent.

TABLE 9-12. ANNUAL CANCER INCIDENCE REDUCTION (FISH CONSUMPTION BY ANGLERS)

	Direct Dischargers	Indirect Dischargers	Total
Metals Option 4	0.000	0.000	0.000
Oils Option 8	0.000	0.648	0.648
Oils Option 9	0.000	0.653	0.653
Organics Option 4	0.000	0.000	0.000
Combined Regulatory Option			0.649

Noncancer Risks. Estimating noncancer risks involves the same initial steps as those outlined above for cancer risks. Using the first two steps described above for cancer risks, EPA estimated concentrations in fish tissue for each of the chemicals with noncancer health effects at each reach. At this stage, rather than estimating cancer risk, the Agency compared the estimated average daily dose of each chemical with its reference dose (RfD) (see Table 9-7). The ratio of the estimated dose to the RfD is known as the *hazard quotient.* If this expression summed across all pollutants affecting a reach is greater than one, a potential noncancer health effect may result from exposure.

As shown in Table 9-13, that analysis showed that only reaches in the metals and oils subcategories are a potential source of noncancer health effects under baseline conditions. For discharges associated with these two subcategories, a total of two reaches will have noncancer health effects and about 19,000 people will be exposed. Under the regulatory options, no reaches have noncancer health effects. However, it is important to note again that a critical assumption in the analysis asserts that no background concentrations of these chemicals exist in the affected reaches. The results could change considerably if background concentrations do exist. In particular, the current estimates may underestimate noncancer risks. Unfortunately, evidence is insufficient at this time to determine the accuracy of this assumption.

Lead-Related Health Effects. Based on the loadings estimates for CWT facilities, the analysis showed a reduction in lead loadings to four reaches that would cause meaningful and measurable reductions in lead-related health effects from fish consumption. For each of these reaches, the analysis estimated blood lead levels separately for recreational and subsistence anglers and for their families under both baseline conditions and with the proposed regulatory option in place.

TABLE 9-13. POPULATIONS AT RISK FOR NONCANCER HEALTH EFFECTS THROUGH FISH CONSUMPTION

	Direct Dischargers		Indirect Dischargers		Total	
	Number of Affected Reaches	**At-Risk Population**	**Number of Affected Reaches**	**At-Risk Population**	**Number of Affected Reaches**	**At-Risk Population**
Baseline						
Metals	0	0	1	16,800	1	16,800
Oils	0	0	1	2,100	1	2,100
Organics	0	0	0	0	0	0
Combined Baseline[a]	0	0	2	18,900	2	18,900
With Regulation						
Metals Option 4	0	0	0	0	0	0
Oils Option 8	0	0	0	0	0	0
Oils Option 9	0	0	0	0	0	0
Organics Option 4	0	0	0	0	0	0
Combined Regulatory Option					0	0

[a] Some reaches receive discharges from more than one subcategory; therefore, the combined baseline total may be less than the total of the subcategories.

To estimate the total exposed populations at each reach, EPA used the same population estimates for anglers and their families that were used for the cancer risk analysis. To subdivide these populations into the age and gender categories that are relevant for measuring lead-related health effects, the Agency assumed that the age and gender distribution of these families is the same as for the U.S. as a whole based on percentages contained in the *1997 Statistical Abstract of the U.S.* EPA estimated the exposed populations in each gender-age category was estimated by multiplying the total exposed population for each reach by the corresponding age-gender population percentage.

EPA used the population and blood lead level estimates to assess reductions in six general categories of health effects associated with lead exposure. As shown in Table 9-14, these categories include hypertension for adult males, changes in IQ for children exposed before the age of seven, and neonatal mortality resulting from exposure during pregnancy. In addition, it includes a number of health effects associated with elevated diastolic blood pressure levels, an outcome which is also known to result from adult lead exposures. These health effects include coronary heart disease (CHD), cerebrovascular accidents (CA), brain infarctions (BI), and mortality.

To estimate changes in these health effects, EPA applied the same methodology that is used in *The Benefits and Costs of the Clean Air Act, 1970 to 1990* (EPA, 1997--see Appendix G). It includes dose-response specifications for each of the health effects and age-gender categories identified in Table 9-14, and it also specifies the monetary value of losses associated with each health effect.

Using Equation (11) from Appendix G of the CAA study, EPA estimated changes in the probability of hypertension for men ages 20 to 74. The total estimated exposed population in the group is about 29,800, and the estimated reduced incidence of hypertension is 3.2 cases per year.

TABLE 9-14. REDUCTIONS IN LEAD-RELATED HEALTH EFFECTS

Health Effect	Affected Population			Annual Incidence Reduction
	Gender	Age Group	Size	
Hypertension	Males	20-74	29,800	3.209
Coronary Heart Disease	Males	40-59	12,700	0.135
		60-64	1,600	0.028
		65-74	2,900	0.022
	Females	45-74	13,300	0.010
Cerebrovascular Accidents	Males	45-74	12,000	0.008
	Females	45-74	13,300	0.004
Brain Infarctions	Males	45-74	12,000	0.005
	Females	45-74	13,300	0.003
Mortality	Males	40-54	9,100	0.159
		55-64	3,600	0.022
		65-74	2,900	0.011
	Females	45-74	13,300	0.006
	Both	neonates	1,400	0.024
IQ Changes				
Changes in IQ points	Both	0-6	9,600	72
Changes in number of children with IQ<70	Both	0-6	9,600	34

Changes in the probability of CHD, CA, BI, and adult mortality are based on changes in diastolic blood pressure (DBP) for men and women. First, using Equations (12) and (21) respectively from Appendix G of the CAA study, the analysis estimtated changes in DBP for males and females. Second, assuming that the regulation would reduce DBP to normal adult levels (specified to be 80 mm Hg), the (absolute value of the) estimated change in DBP was added to this to approximate baseline DBP for the exposed populations. Third, applying the baseline and with-regulation DBP estimates to Equations (13) through (25) from Appendix G of the CAA study, EPA estimated the change in probability of CHD, CA, BI, and adult mortality. Fourth, multiplying these values by their respective populations and dividing this by the number of years in each age category, the Agency estimated the *annual* reduction in incidence for each health effect. As shown in Table 9-14, the annual reduction in CHD is 0.2 cases per year, with the majority of this decline for males ages 40 to 59. The annual reduction in CA and BI incidence is about 0.013 and 0.007 cases per year, respectively. The annual reduction in mortality is about 0.2 deaths per year, with a majority of the decline in males ages 40 to 54.

To estimate reductions in neonatal mortality, EPA first estimated the number of pregnant women in the exposed population. To do this, the Agency assumed that the percentage of pregnant women in the exposed population is equal to the birth rate (per 100 individuals) in the U.S. as a whole, which was acquired from the *1997 Statistical Abstract of the U.S.*, and multiplied this value by the total exposed population. Appendix G of the CAA study indicates that the risk of infant mortality decreases by 0.0001 for each 1 μg/dL decrease in maternal blood lead level during pregnancy (p. G-8). Applying this dose-response relationship, EPA estimates the reduction in the incidence of neonatal mortality to be approximately 0.02 deaths per year.

Two separate effects related to children's (ages 0 to 6) IQ were measured: (1) the reduction in IQ points due to elevated blood lead levels and (2) the reduction in the number of children with IQs less than 70. Using Equation (5) from Appendix G of the CAA study, EPA estimated that the exposed population of approximately 9,600 children would gain a total of roughly 72 IQ points as a result of the proposed rule. Using Equations (6) through (10) from Appendix G of the CAA study, EPA estimated the reduction in the proportion of children with IQs less than 70. To estimate the annual reduction in the number of children with IQs less than 70, EPA divided this value by the number of years in the age category (i.e., 7 years) and then multiplied by the size of the exposed population (i.e., 9,600 children). EPA estimated that approximately 34 fewer children would have IQs below 70.

Limitations and Uncertainties in the Measurement of Health Impacts. The preceding analysis has focused largely on the health effects associated with fish consumption from the CWT reaches. Estimating these impacts required a number of analytical steps, each of which required simplifying assumptions and an inevitable degree of uncertainty. This section addresses some of the limitations and uncertainties of the analysis and discusses how they may affect the results.

The analysis was restricted to only one reach on each waterway receiving CWT discharges. For each direct discharger and each affected POTW, EPA analyzed water quality and related impacts for only a single reach and did not consider impacts downstream from these reaches. Through dilution, volatilization, and other processes, concentrations of the pollutants will decline as one moves downstream; therefore, the downstream impacts will be less than in the directly affected reaches. Nevertheless, excluding them from the analysis will result in underestimates of the health impacts of the proposed regulation. In certain cases the analysis may not have been captured upstream impacts, for example, if contaminated fish migrate in that direction.

The analysis assumed that background concentrations of each pollutant are zero. This analysis did not explicitly address discharges of the pollutants from sources other than CWT facilities. Therefore, all modeled concentrations are from CWT discharges. Although this simplification may understate baseline cancer risks from fish consumption or drinking water for the affected reaches, it will not alter the estimated *reductions* in cancer risk due to the proposed regulation. In contrast, assessments of ecological and noncancer impacts, which are based on a threshold model, are very sensitive to the accuracy of this assumption.

Whether the assumption will lead to overstatements or understatements of impacts is uncertain. Accounting for background concentrations will tend to increase the number of baseline exceedances of aquatic life and human health thresholds. If these background concentrations are sufficiently high, however, the number of exceedances eliminated as a result of the proposed regulation may in fact decrease.

Estimation of the number of anglers using the affected reaches has not considered the quality of substitute sites. Estimation of the size of the population affected by fish consumption required a number of simplifying assumptions. A potentially important omission in the analysis has been the lack of consideration of water quality in other waterways that may serve as substitute sites for the affected reaches. For example, EPA assumed that anglers within the designated buffer zones are equally likely to visit each reach mile within the zone. If water quality at other reaches is distinctly better (worse) than in the affected reach, then the estimates of the exposed populations are likely to be too high (low).

The impact of fishing advisories is very uncertain. Twenty-two of the 83 affected reaches have fish consumption advisories. The analysis accounted for this by adjusting the exposed population downward by 20 percent. This adjustment, however, is subject to considerable uncertainty. Studies show that approximately 80 percent of anglers are aware of fishing advisories and many do not change their fishing behavior. For example, Diana, Bisogni, and Gall (1993) found that anglers vary in their beliefs about the credibility of fishing advisories, and Belton, Roundy, and Weinstein (1986) also found evidence that individuals tend not to change their behavior. For those who do change locations, many may simply be switching to other locations where advisories are in place.

Other studies further have found that, although fishermen may not substantially change their *fishing* behavior in response to fish consumption advisories, they may change their overall *consumption* patterns. For example, Diana, Bisogni, and Gall (1993) found that

56 percent of the households that ate the restricted fish did follow the recommended trimming techniques that significantly reduce the amount of pollutants consumed. Fiore et al. (1989) also found a high percentage of individuals that change their consumption patterns—57 percent of fishermen who were aware of the advisories did change their preparation or cooking habits.

The analysis assumes no behavioral changes as a result of water quality improvements. The analysis assumes that the number of anglers fishing the affected reaches and the fish consumption rates and practices of these anglers and their families do not change from the baseline. For the water quality changes to have an effect on angling or fish consumption activities they must have an impact that is perceptible to potential users of the waterbodies. Although the proposed regulation will lower the in-stream concentrations of several pollutants, these changes may not alter the directly observable qualities of the surface water, such as its clarity or odor, or the fish that are caught. If this is the case, then the assumption of no behavioral change is appropriate. However, as discussed in Section 9.4.2.1, hazards to aquatic life from the pollutants in CWT facility effluents will be reduced as a result of the proposed regulation, and this may have an impact that is perceptible to anglers. If the visual characteristics of the aquatic environment improve or if catch rates increase for anglers, these effects will enhance fishing activities. Current information is inadequate to determine the extent to which such observable changes occur. In general, the more perceptible water quality changes are, the more likely it is that this approach will (1) overestimate baseline exposures (i.e., anglers will avoid observably poor water quality) and (2) underestimate increases in angling and fish consumption rates.[7] In both cases, the likelihood that health risk reductions are overestimated is increased. At the same time,

[7]Increases in consumption rates and/or increases in the number of users may have the effect of increasing exposure to residual levels of contamination in the surface water. Increased exposure will counteract some of the improvements in health outcomes.

however, this increases the likelihood of nonhealth recreation benefits accruing to the improved waterbodies.

Other Potential Impacts. As mentioned previously, the proposed regulation will potentially have beneficial impacts in a number of other areas. For market-based activities such as agriculture and manufacturing that use water as a production input, improvements in water quality can lower production costs and improve productivity. This can increase profits for producers and/or lead to lower prices for consumers. Unfortunately, currently available data are insufficient to quantify these impacts.

In addition to lowering the health risks to anglers and their families who consume fish from the affected reaches, improvements in water quality can have beneficial impacts for anglers in other ways. Clearly individuals gain satisfaction from aspects of fishing experiences other than those related to the health consequences of consuming their catch. A number of recreation studies have shown that other aspects of fishing such as being outdoors and experiencing natural surroundings are the most important contributors to the enjoyment of fishing experiences (Fedler and Ditton, 1986; Holland and Ditton, 1992). If improvements in water quality lead to perceptible improvements in fishing experiences, then they will provide recreation benefits to anglers. Furthermore, if broader ecological impacts occur that, for example, improve opportunities for viewing other forms of wildlife, this will also improve recreational experiences. These types of changes are likely to not only positively affect current users of the affected waterways but to also increase the number of users as well. Current evidence is insufficient to reliably estimate the magnitude of these behavioral changes. In the next section, the analysis described assumes that the number of recreational anglers visiting these reaches remains the same after the water quality improvements. However, this analysis does estimate how the recreation benefits to these anglers would increase if they were able to perceive the estimated water quality improvement resulting from the proposed regulation.

9.4.3 Valuation of Surface Water Quality Improvements

EPA expects two primary types of benefits to result from surface water quality improvements under the proposed regulation. The first is improved health benefits from reduced exposures to toxic substances and the second is increased recreation benefits due to improvements in the quality of recreational surface water resources. This section describes the methods used to assess health and recreation values and provides estimates of the corresponding monetary benefits for the proposed rule.

9.4.3.1 Health Benefits

It is now largely accepted in the economics profession that an individual's maximum WTP for an additional unit of a good represents the benefits of acquiring the extra unit.[8] Therefore, WTP is the appropriate welfare measure for assessing benefits, and it can be applied to valuing improvements in human health in the same way that it is applied to valuing consumer goods. As discussed in the previous sections, a wide variety of health effects have been associated with CWT pollutants. However, changes in the incidence (or outcomes) of disease can only be quantified for a subset of these effects: cancers and lead-related health effects. This section discusses separately the values associated with avoiding these health effects.

The Benefits of Avoided Cancer Cases from Fish Consumption. Because cancer is an often-fatal disease, individuals' WTP for reductions in cancer risk is approximated by the WTP for reductions in the risk of premature death. The WTP approach for valuing a statistical life saved (or a statistical death avoided) focuses on the amount individuals are

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[8]The individual's minimum willingness to accept (WTA) compensation for losing or forgoing the opportunity to acquire a unit of the good is also a valid measure of benefits, and, in principle, it should be approximately the same as WTP.

willing to pay to reduce their risk of premature death or, conversely, what compensation they require to increase their risk. Conceptually, once a value is established for a specific unit change in risk (such as a one in one million change in the probability of premature death), it is simply a matter of scaling this value so that it corresponds to a change in probability equal to one.[9] For example, if individuals have, on average, a WTP of $5 to avoid a one in one million chance of premature death, this value aggregates to $5 million to avoid the probability that one death will occur in a population of 1 million of these individuals. In other words, it aggregates to $5 million for one *statistical* death avoided, which, in turn, represents what is known as the value of a statistical life saved.

There are a number of empirical studies conducted since the mid-1970s that measure individuals' valuations of death risk changes. These generally fall into three categories:

- wage-risk studies, which focus on the wage compensation individuals require to accept a riskier occupation;
- contingent valuation (CV) studies in which individuals are asked in surveys to state their WTP for changes in risk; and
- consumer studies, which focus on individuals' revealed WTP in markets for goods that influence their risk of death (such as automobiles and smoke detectors).

Two articles, in particular, have surveyed these empirical studies to establish a range of values for a statistical life saved. Fisher, Chestnut, and Violette (1989) examined over 30 studies, most of which used a wage-risk approach. They conclude that the "most defensible" range of estimates is between $2.3 and $12.4 million ($ 1997). More recently, Viscusi (1993) reexamined and updated the range of studies. He places the most confidence

[9]In other words, one aggregates across individuals so that their independent changes in probability sum to one (i.e., so that the expected change in premature deaths in that population is equal to one). In this way, the value of a statistical death avoided is the sum of the individuals' WTP for a risk change.

in the wage-risk studies that produce values in the range of $5.1 to $8.1 million ($ 1993) and a consumer study of automobile purchases (Atkinson and Halvorsen, 1990) that estimates a value of approximately $4 million per statistical life saved.

Based on the conclusions of the two survey articles, $5 million is a reasonable point estimate of a statistical life saved. However, at least two inherent difficulties are associated with the empirical studies reviewed. The first is the ability to measure accurately the risks faced by individuals in wage-risk and consumer-risk situations. Wage-risk studies have tended to rely on observed occupational death rates in broad industry categories.

Second, even in CV studies in which the investigator establishes the level of risk, individuals' perceptions of risk may not correspond well with the more objective probabilities used in the studies. Slovic, Fischhoff, and Lichtenstein (1979) have shown that risk perceptions often differ significantly from observed death rates and that individuals have a tendency to overestimate very small risks and underestimate very high ones. Furthermore, individuals often have difficulty conceptualizing risk in terms of numerical probabilities, particularly very small ones.

Despite these limitations, a growing body of research in this area continues to support estimates in the ranges mentioned above. To account for the uncertainty in the value of a statistical life and to maintain consistency with other analyses of effluent guidelines (EPA, 1995), EPA used a range of $2.3 million to $12.4 million to value a cancer case avoided.

Table 9-15 reports the monetized benefits of the reductions in annual cancer incidence from each of these regulatory options. The reductions in annual cancer incidence for each regulatory option range from zero to almost one cancer case per year. The combined option value of these cancer cases avoided is estimated to be in the range of approximately

TABLE 9-15. ANNUAL BENEFITS FROM REDUCTION IN CANCER INCIDENCE FROM FISH CONSUMPTION ($ 1997)

	Direct Dischargers	Indirect Dischargers	Total
Metals Option 4	$0–$0	$0–$0	$0–$0
Oils Option 8	$0–$0	$1,421,000–8,040,000	$1,421,000–8,040,000
Oils Option 9	$0–$0	$1,503,000–8,101,000	$1,503,000–8,101,000
Organics Option 4	$0–$0	$1,000–$3,000	$1,000–$3,000
Combined Regulatory Option			$1,492,000–$8,043,000

$1.5 million to $8.0 million per year. As indicated in Table 9-15, the majority of these benefits are attributable to the oils options.

The Benefits of Avoided Lead-Related Health Effects from Fish Consumption. As summarized in Table 9-14, changes in several discrete health effects associated with lead exposures can be quantified for the proposed rule. Assuming that individuals' WTP to avoid risks of death do not vary significantly across different types of fatal illness, the mortality effects related to high blood pressure and to prenatal exposures from lead exposure can be valued using the same approach applied to value avoided cancer cases—by assuming a range of $2.3 million to $12.4 million per statistical life saved.

To assess the values of avoided morbidity effects associated with lead exposure, EPA used the same values as reported in Appendix G of the CAA study to estimate individuals' WTP to avoid each case (or related outcome) of these health effects. Table 9-16 reports these values as unit values ($ 1997). By and large, these values are based on "cost-of-illness" (COI) measures, which include estimates of the average medical expenditures and lost earnings associated with each health outcome. Because these COI estimates do not value the losses in well-being from pain and suffering due to illness, they are best interpreted as lower-bound estimates of the total WTP to avoid each health outcome. Table 9-16 reports the monetized annual benefits of the reductions in lead-related health effects as a result of the proposed rule. EPA estimates the total value to be in the range of approximately $3.0 million to $5.2 million per year. As indicated in the table, the majority of these benefits are attributable to reductions in adverse IQ effects in children and to avoided mortality due to prenatal exposures and to high blood pressure.

TABLE 9-16. ANNUAL BENEFITS FROM REDUCTION IN LEAD-RELATED HEALTH EFFECTS FROM FISH CONSUMPTION ($ 1997)

Health Effect	Affected Population: Gender	Affected Population: Age Group	Unit Values for Lead-Related Health Effects (1997$)	Total Annual Value (1997$)
Hypertension	Males	20-74	$838	$2,700
Coronary Heart Disease	Males	40-59	$63,960	$8,700
		60-64	$63,960	$1,800
		65-74	$63,960	$1,400
	Females	45-74	$63,960	$600
Cerebrovascular Accidents	Males	45-74	$246,000	$2,000
	Females	45-74	$123,000	$500
Brain Infarctions	Males	45-74	$246,000	$1,200
	Females	45-74	$123,000	$300
Mortality	Males	40-54	$2,300,000 – $12,400,00	$382,200 – $1,973,400
		55-64	$2,300,000– $12,400,00	$50,700 – $272,000
		65-74	$2,300,000– $12,400,00	$24,700 – $132,300
	Females	45-74	$2,300,000– $12,400,00	$14,400 – $77,300
	Both	Neonates	$2,300,000– $12,400,00	$56,400 – $302,600
IQ Changes				
Changes in IQ points	Both	0-6	$3,637	$262,000
Changes in number of children with IQ<70	Both	0-6	$64,800	$2,199,000
Total				$2,999,000 – $5,242,000

9.4.3.2 Recreation Benefits

In addition to the health benefits of improving water quality in the affected reaches, individuals will potentially benefit from enhanced recreational opportunities as well. As previously discussed, these recreational opportunities include a wide range of in-stream and near-stream activities. The values derived from these enhanced opportunities, however, are likely to be largest and can most reliably be estimated for recreational fishing.

Studies of recreational fishing have shown that a number of aspects contribute to the enjoyment of fishing experiences. In addition to the value received from being able to safely consume their catch, recreational anglers derive much of their satisfaction from the natural surroundings and the ecological health of the recreation site (Fedler and Ditton, 1986; Holland and Ditton, 1992). Therefore, to assess the recreation benefits of the proposed rule, EPA used attainment of the AWQC for human health aquatic life as the primary indicator of where recreation benefits would accrue if anglers were aware of water quality improvements.

The Agency used three fundamental steps to measure recreational fishing values. First, EPA determined which of the affected reaches would achieve both aquatic life and human health AWQCs as a result of the proposed rule. Second, EPA estimated the baseline annual value of recreational fishing activities at these reaches by combining our previously estimated measures of fishing participation (i.e., number of recreational anglers using the site) with estimates of the average number of fishing days per year and the average value of a fishing day. Third, EPA estimated the increase in annual value from the baseline for the selected reaches using evidence from a study that measured anglers' WTP for the removal of contamination from recreational fishing areas (Lyke, 1993). We discuss each of these steps below.

Step 1: Distinguish Reaches That Achieve AWQCs As a Result of Proposed Regulation. Section 9.4.2.1 describes the AWQCs for aquatic life. Section 9.4.2.3 describes those for human health. For purposes of this analysis, a reach achieves "contaminant-free" status, and thus provide additional recreation benefits, if it exceeds at least one AWQC in the baseline and would exceed no AWQCs with regulation. As shown in Table 9-17, 18 reaches exceed at least one of the AWQCs under baseline conditions. Under the regulatory options, this number declines to 2 exceedances for Metals Option 4, 9 exceedances for both Oils Option 8 and Oils Option 9, and one exceedance for Organics Option 4. Under the Combined Regulatory Option, there are 13 reaches with exceedances—a reduction of 5 from the combined baseline.

Step 2: Measure Baseline Annual Value of Recreational Fishing at These Reaches. Section 9.4.2.2 discusses the estimated fishing populations at the affected reaches. These estimates are based on

- the population and the total number of miles of stream reaches within a 30-mile buffer zone around the affected reach,
- fishing participation rates within the state as a whole, and
- the existence of fishing advisories on the affected reach.

The number of recreational anglers at each reach varies from fewer than 31 anglers to more than 23,000. Using state-level data from the 1996 *National Survey of Fishing, Hunting, and Wildlife Associated Recreation*, EPA then estimated the average number of freshwater fishing days per recreational angler (DOI, 1997). For the 36 states in which these reaches are found, the averages vary from roughly 8 to 23 days per year. Multiplying the estimated number of anglers by the estimated number of trips per angler per year provides an estimate of the total number of fishing days per year at each reach.

TABLE 9-17. NUMBER OF REACHES WITH EXCEEDANCES OF AT LEAST ONE OF THE FOUR AWQCS

	Direct Dischargers	Indirect Dischargers	Total
Baseline			
Metals	1	1	2
Oils	0	15	15
Organics	1	4	5
Combined Baseline[a]	2	16	18
With Regulation			
Metals Option 4	1	1	2
Oils Option 8 (Indirect)	—	9	9
Oils Option 9 (Direct)	0	—	0
Organics Option 4	1	0	1
Combined Regulatory Option			13

[a] Some reaches receive discharges from more than one subcategory; therefore, the combined baseline total may be less than the total of the subcategories.

According to economic theory, the value of an angler's fishing day is equal to the maximum the angler would have been willing to pay for the fishing day *minus* the actual costs, both explicit and implicit costs, of the fishing day. A number of empirical models have been developed to estimate these recreation values, and they generally fall into two categories. On the one hand, *travel cost models* (TCMs) rely on observed recreational behavior and estimates of the actual costs of a recreation day (most importantly the time and out-of-pocket expenses associated with the trip) to estimate recreation values. *CV models,* on the other hand, are survey-based approaches that rely on respondents' expressed WTP for recreation to measure their values. Walsh, Johnson, and McKean (1992) conducted a meta-analysis of TCM and CV studies that measured the per-day values of various types of recreational activities and found the average value of a warm water fishing day to be approximately $34 (in 1997 dollars). Smith and Kaoru (1990) conducted a similar study of only TCM recreation studies and found per-day fishing values of approximately $34, as well.

Step 3: Estimate Increase in the Annual Value of Recreational Fishing. Reducing the level of contaminant concentrations in the affected reaches to meet AWQCs may provide additional benefits to recreational anglers by reducing health risks and improving aquatic ecosystems. Research by Lyke (1993) has shown that anglers may place a significantly higher value on a contaminant-free fishery than a fishery with some level of contamination. Specifically, Lyke estimated (1) the consumer surplus associated with Wisconsin's recreational Lake Michigan trout and salmon fishery and (2) the additional value of the fishery if it were completely free of contaminants affecting aquatic species and human health. The estimated incremental WTP associated with freeing the fishery of contaminants ranges from 11.1 percent to 31.3 percent of the value of the fishery under current conditions. Applying this range of percentage increases to the average value of a fishing day implies an incremental value per fishing day of $3.70 to $10.40. When these values are applied to the total number of fishing days at reaches where all AWQC exceedances are estimated to be eliminated, the range of total annual recreation fishing benefits is $414,000 to $1.2 million. This range underestimates recreation-based benefits because data were not available to estimate angler populations for one of the five reaches at which benefits occur. As Table 9-18 shows, the annual value of reducing AWQC exceedances is greatest under Organics Option 4. The total value under the Combined Regulatory Option is less than the sum of either oils options and the organics option because three of the reaches meeting all of the criteria under the organics option remain in exceedance under the oils option. Therefore, no benefits are attributed to these three reaches under the Combined Regulatory Option.

Limitations and Uncertainties Associated with the Estimates of Recreational Fishing Benefits. The previously described approach for estimating recreational fishing

TABLE 9-18. ANNUAL RECREATION VALUE OF REDUCING AWQC EXCEEDANCES ($ 1997)

	Direct Dischargers	Indirect Dischargers	Total
Metals Option 4	$0–$0	$0	$0
Oils Option 8	$0–$0	$393,000–$1,117,000	$393,000–$1,117,000
Oils Option 9	$0–$0	$393,000–$1,117,000	$393,000–$1,117,000
Organics Option 4	$0–$0	$727,000–$2,066,000	$727,000–$2,066,000
Combined Regulatory Option			$414,000–$1,177,000

values is an application of *benefits transfer*. It involves using values for a “commodity” estimated in one context—fishing days and water quality improvements—and transferring them to a separate context (i.e., CWT reaches). Such a transfer allows analysts to estimate benefits without having to conduct expensive primary data collection and analysis, but it also inevitably involves uncertainties. Therefore, a number of important caveats should be considered when interpreting the results.

First, the value of a fishing day from the Walsh, Johnson, and McKean study is more likely to reflect waterbodies that are of average (and perhaps above average) quality, whereas, based on limited available information, the baseline quality of the affected reaches is more likely to be below average than above average. The affected reaches are primarily located in urban areas, and, as shown in Table 3-16, 22 of these reaches have fishing advisories. The existence of these fishing advisories has been accounted for by adjusting participation rates by 20 percent. However, because no other adjustment has been made for baseline water quality, the baseline fishing day values for the affected reaches may be an overestimate.

Second, in the Lyke study, individuals were asked to value a reduction in contamination that is complete and for all of the Great Lakes. Although the proposed rule will almost entirely eliminate pollutant concentrations in CWT effluents, background levels may be greater than zero in some of the reaches. Therefore, contamination may not be completely eliminated by the proposed rule. Furthermore, the proportionate change in value from eliminating contamination in *all* Great Lakes is likely to be higher than from eliminating contamination in the *individual* CWT reaches because the CWT reaches are likely to have more close substitutes. This suggests that transferring Lyke’s findings will also tend to overstate the benefits of the proposed rule.

Third, it is not clear what impacts Lyke’s survey respondents associated with eliminating contamination in the Great Lakes. As a result, the basis for their expressed values is somewhat indeterminate. It is probably safe to assume that some of these values reflect reductions in perceived health risks, but there is no way to know how well these correspond with the types and magnitudes of health risk reductions at the CWT reaches. To the extent that the survey respondents implicitly considered cancer risk reductions in their WTP responses, the estimated recreation benefits in Table 9-17 will at least partially double-count the estimated value of cancer risk reductions shown in Table 9-15. Without more information, the degree of double-counting cannot be determined. Because noncancer risk reductions for the CWT reaches (Table 9-13) cannot be monetized, there is no double-counting of the value of these risk reductions. Based on the analysis described in Section 9.4.2.3, however, the proposed rule is not anticipated to provide large noncancer risk reduction benefits.

These three caveats indicate that adding the estimated recreation benefits to the cancer risk reduction benefits will tend to overstate benefits from the proposed rule. However, because EPA did not measure downstream improvements in water quality, these estimates may also fail to capture important downstream recreation benefits. In addition, using a threshold model (with the AWQC as the threshold) and assuming zero background concentrations may either overstate or understate benefits if background concentrations of affected pollutants do, in fact, exist.

9.4.4 POTW Sludge Disposal Cost Savings

The benefits discussed in this section, POTW sludge disposal cost savings, are fundamentally different from those discussed in the previous section in one respect: the benefits to POTWs occur before the CWT pollutants are released into the environment. All of the benefits discussed in Section 9.4.3 originate from changes in environmental systems, namely the water quality and ecological impacts on the receiving waterbodies. The cost savings discussed and quantified in this section are separate from any changes in surface water quality.

The benefits to POTWs may occur because reduced discharges from CWT facilities will, in many cases, reduce POTW operating costs. The treatment of wastewater by POTWs produces a sludge that contains pollutants removed from wastewater. POTWs must use or dispose of this sludge in compliance with state and federal requirements. These requirements vary with the pollutant concentration of the sludge. Because the proposed regulatory options will require reductions in pollutant levels in wastewater from CWTs, the sewage treatment systems that receive these discharges are expected to generate sewage sludge with reduced pollutant concentrations. As a result, the POTWs should be able to use or dispose of the sewage sludge at a lower cost. In some cases, POTWs may be able to dispose of the cleaner sludge by using it in agricultural applications, which will generate additional agricultural productivity benefits. This section assesses the potential economic benefits resulting from cleaner sewage sludge and develops a partial estimate of the benefit value. Also, it discusses in detail the cost savings associated with reduced pollutant contamination of effluent discharged by CWT facilities to POTWs.

9.4.4.1 Overview of Benefits to POTWs from the Proposed Regulation

Several benefits are expected to result from reduced contamination of sewage sludge. Eight of the primary benefits are outlined below.

1. POTWs may be able to use or dispose of sewage sludge through less expensive means. CWA regulations (40 CFR Part 503) contain limits on the concentrations of pollutants in sewage sludge when used or disposed of through specified means. As a result of the proposed regulations, sewage sludge from some POTWs may meet more stringent limits, which, in turn, will permit less expensive use or disposal of the sewage sludge. In the best case, sewage sludge will meet land application pollution limits. This sewage sludge may be disposed of via land

application, which in some instances may be substantially less costly than other use or disposal practices (e.g., incineration or landfilling).

2. Some sewage sludge that currently meets only land application ceiling concentration limits and pollutant loading rate limits will meet the more stringent land application pollutant concentration limits as a result of the proposed regulation. Entities that apply these sewage sludges face fewer recordkeeping requirements than users of sewage sludge that meets only land application ceiling concentrations and loading rate limits. Further, POTWs producing sewage sludge that meets the pollutant concentration limits have no application rate limits other than the agronomic rate (determined by the nitrogen needs of crops and the plant-available nitrogen at the application site).

3. By land-applying sewage sludge, POTWs may avoid costly siting negotiations regarding other sewage sludge use or disposal practices, such as incinerating sewage sludge.

4. POTWs may use the nitrogen content of the sewage sludge to supplement other sources of nitrogen. Sewage sludge applied to agricultural land, golf courses, sod farms, forests, or residential gardens is a valuable source of fertilizer.

5. The organic matter in land-applied sewage sludge can improve crop yields by increasing the ability of soil to retain water.

6. Nonpoint source nitrogen contamination of water may be reduced if sewage sludge is used as a substitute for chemical fertilizers on agricultural land. Compared to nitrogen in most chemical fertilizers, nitrogen in sewage sludge is relatively insoluble in water. The release of nitrogen from sewage sludge occurs largely through continuous microbial activity, resulting in greater plant uptake and less nitrogen runoff compared to conventional chemical fertilizers.

7. Reduced sewage sludge concentrations of pollutants that are not currently subject to sewage sludge pollutant concentration limits will reduce human health and environmental risks. Human health risks from exposure to these unregulated sewage sludge pollutants may occur from inhalation of particulates, dermal exposure, ingestion of food grown in sewage sludge-amended soils, ingestion of surface water containing sewage sludge runoff, ingestion of fish from surface water containing sewage sludge runoff, or ingestion of contaminated ground water.

8. Land application of sewage sludge satisfies an apparent public preference for this practice of sludge disposal, apart from considerations of costs and risk.

Although each of these benefits may be substantial, only the first benefit from the above list—shifts to less expensive sewage sludge use or disposal practices—is quantified in this report. The remaining benefits categories associated with reduced sewage sludge contamination were not quantified largely because of data limitations. The next section monetizes the first benefit listed and discusses each of the steps taken to arrive at a monetary value for this benefit.

9.4.4.2 Monetization of One of the Primary Benefits to POTWs

The basic concept underlying quantification of shifts to less expensive sewage sludge use or disposal practices is that POTWs choose the least expensive sewage sludge use or disposal practice for which their sewage sludge meets pollutant limits. Sewage sludge applied to agricultural land or placed on a surface disposal site is subject to stricter pollutant limits than sewage sludge used or disposed of by other practices. However, these use or disposal practices are, however, also generally less expensive than the alternatives. Therefore, POTWs with sewage sludge pollutant concentrations that exceed the land application for surface disposal pollutant limits in the baseline may be able to reduce sewage sludge use or disposal costs when pollutant emissions from CWT facilities are reduced. EPA estimated the number of POTWs and associated quantity of sewage sludge that will meet land application pollutant limits and surface disposal pollutant limits before and after the regulation is implemented. From the estimates of the relative costs of sewage sludge or disposal practices, the Agency then estimated the cost savings that would accrue to POTWs from the quantities of sewage sludge that qualify for land application or surface disposal practices. The current sludge use and disposal practices and the cost savings methodology used to monetize the benefits from changing these practices are the focus of this section.

Current Sewage Sludge Generation, Treatment, and Disposal Practices. Provided below is a brief description of the sewage sludge characteristics and treatment processes and the methods of sludge use or disposal.

Sewage Sludge Characteristics and Treatment. Sewage sludge contains five classes of components: organic matter, pathogens, nutrients, inorganic chemicals, and organic chemicals. The mix and level of these components ultimately determine the public health and environmental impact of sewage sludge use or disposal and may also dictate the most appropriate use or disposal practice.

Sewage sludge is generated as a result of the treatment of domestic wastewater in conjunction with wastewater indirectly discharged to surface water via POTWs. The chemical and physical characteristics of the sewage sludge will depend on the extent and type of wastewater treatment used (i.e., primary, secondary, or advanced wastewater treatment). To reduce the volume of the sewage sludge generated, the sludge may be conditioned, thickened, stabilized, or dewatered.

Sewage Sludge Use or Disposal Practices. After sewage sludge has been treated, it is either disposed of or beneficially used. The use or disposal practice chosen depends on several factors. These factors include the cost of preparing the sewage sludge for the chosen use or disposal practice, pollutant concentrations, the availability of markets for sewage sludge, the availability of suitable sites for use or disposal, the costs of transporting sewage sludge to these sites, state environmental regulations, and public acceptance. Many POTWs use more than one use or disposal practice to maintain operating flexibility and avoid capacity limitations of a single practice.

There are four major sewage sludge use or disposal practices:

1. *Land Application:* the spraying or spreading of sewage sludge onto the land surface, the injection of sewage sludge below the land surface, or the incorporation of sewage sludge into the soil so that the sewage sludge can either condition the soil or fertilize crops or vegetation grown in the soil. Sewage sludge is applied to agricultural lands (pasture, range land, crops); forest lands (silviculture); and drastically disturbed lands (land reclamation sites); or may be sold or given away in a bag or other container for application to the land (formerly known as distribution and marketing).

2. *Surface Disposal*: placing sewage sludge into an area of land for which only sewage sludge is placed for final disposal. Surface disposal includes surface impoundments (also called lagoons) used for final disposal, sewage sludge monofills (i.e., sludge-only landfills), and land on which sewage sludge is spread solely for final disposal (referred to as a "dedicated site").

3. *Incineration*: the combustion of organic and inorganic matter in sewage sludge by high temperatures in an enclosed device.

4. *Co-disposal:* the disposal of sewage sludge in a municipal solid waste landfill (MSWLF) or used to cover material at a MSWLF.

Cost Savings Methodology. As mentioned earlier, sewage sludge for some POTWs will meet more stringent pollutant limits, which, in turn, will permit less expensive use or disposal of sewage sludge. This section describes the methodology used to estimate the total annual cost savings for each of the following proposed regulatory subcategories: Metals Option 4, Oils Option 8, Oils Option 9, Organics Option 4, and the Combined Regulatory Option.

Determine Cost Differentials for Switching from One Sludge Use or Disposal Method to Another. The first step in calculating the cost savings for the proposed regulations was to determine the appropriate range of cost savings for switching from one disposal method to another. EPA used the range of annual cost savings reported in the *Regulatory Impact*

Analysis of Proposed Effluent Limitations Guidelines and Standards for the Metal Products and Machinery (MP&M) Industry (Phase I) (EPA, 1995b) that were estimated using information from several sources. This blend of information is important because costs vary across POTWs; however, the findings of the *Regulatory Impact Analysis for MP&M Industry* indicate that, when ranking the sludge use or disposal practices by cost, the general order is consistent across POTWs. This ranking from least to most expensive is as follows:

1. agricultural land application, surface impoundments, surface disposal to a dedicated site (all approximately the same);
2. monofills;
3. sale or give away in a bag or other container for application to land;
4. co-disposal at a MSWLF; and
5. incineration.

Moreover, EPA judged that the differences in cost between certain combinations of these use or disposal practices (e.g., the cost savings achieved by switching from incineration to land application) are relatively stable despite the wide range of use or disposal costs for given options among individual POTWs (EPA, 1995b).

As mentioned earlier, POTWs may use more than one type of disposal method. Table 9-19 shows two composite sludge use or disposal practice categories for both baseline and post-compliance sewage sludge use or disposal practice. Each of these composite categories assumes a particular mix of sludge use or disposal practices. The first composite baseline sludge use or disposal practice—surface disposal—applies to POTWs with sludge concentrations that meet surface disposal pollutant limits but do not meet land application ceiling pollutant limits. The cost differentials calculated from this baseline are based on the assumption that the POTWs having sludge concentration levels that meet this criterion will

TABLE 9-19. ANNUAL COST SAVINGS FROM SHIFTS IN SLUDGE USE OR DISPOSAL PRACTICES ($1993/DMT)

	Post-Compliance POTW Composite Sewage Sludge Use or Disposal Practice	
Baseline Composite Sewage Sludge Use or Disposal Practices	**Land Application[a]** *Meet surface disposal pollutant limits* *Meet land application pollutant limits*	**Surface[b]** *Meet surface disposal pollutant limits* *Do not meet land application pollutant limits*
Surface[b] *Meet surface disposal pollutant limits* *Do not meet land application pollutant limits*	\$0–\$23	Not applicable
Incineration and co-disposal[c] *Do not meet surface disposal pollutant limits* *Do not meet land application pollutant limits*	\$95–\$205	\$33–\$205

[a] Assumes 100 percent land application.
[b] Assumed disposal mix: 47 percent dedicated site, 28 percent monofils, and 25 percent surface impoundment.
[c] Assumed disposal mix: 32 percent incineration and 68 percent co-disposal.

Source: U.S. Environmental Protection Agency, Office of Water. 1995b. *Regulatory Impact Analysis of Proposed Effluent Limitation Guidelines and Standards for the Metal Products and Machinery Industry (Phase I)*. Washington, DC. EPA Report No. 821-R-95-023.

use a mix of sludge use or disposal practices as follows: 47 percent dedicated site, 28 percent monofils, and 25 percent surface impoundment. The second composite baseline disposal practice—incineration and co-disposal—applies to POTWs with sludge concentrations that do not meet land application or surface disposal pollutant limits. The cost differentials calculated from this baseline assume that POTWs with sludge concentrations that fit this criterion will choose a sludge use or disposal practice mix of 32 percent incineration and 68 percent co-disposal. The two post-compliance disposal practice categories are land application and surface. The land application category is not a composite category because it assumes that all POTWs having sludge concentrations that meet land application and surface disposal pollutant limits will choose to use land application as their only sludge disposal method. The surface category for post-compliance is the same as it was for baseline.

Estimate Baseline Sludge Use or Disposal Method. The next step in determining the sludge disposal cost savings was to determine, for each POTW receiving discharges from CWT facilities, which disposal method is used in the baseline based on estimated pollutant concentrations in their sludge. For each subcategory, EPA calculated the total baseline sludge concentration for the ten pollutants of concern. Each POTW was then matched to one of the composite sludge use or disposal practice categories mentioned in the previous section—land, surface, and incineration/co-disposal—based on exceedances of the relevant limits.

To determine which disposal practice category was appropriate, EPA compared the sewage sludge concentration levels for each POTW with the ceiling limits for land application and the surface disposal limits published in the "Standards for the Use or Disposal of Sewage Sludge" (40 CFR Part 503). As mentioned earlier, if the sludge concentrations met both the land application and surface pollutant limits, the POTW was assumed to use the land application disposal method. Because EPA is quantifying benefits that arose from cost savings from switching disposal practices, and land application is the least expensive disposal practice, all POTWs that had sewage sludge concentrations that met this criterion were dropped from this analysis. Each POTW in the analysis was assumed to receive discharges from only one facility, and 137 facilities were included in the analysis. Out of these 137 facilities, 116 facilities had baseline sludge concentration limits that did not meet the land application pollutant levels. If the sludge concentration at POTWs met the surface disposal pollutant limits but did not meet the land application pollutant limits, the POTWs were assumed to use the surface composite disposal practice. This was the case for 113 POTWs. The remaining three POTWs, those that had sludge concentrations that did not meet either the land application or surface disposal pollutant limits, were assumed to use the disposal mix of incineration and co-disposal.

Estimate Post-Compliance Composite Sludge Use or Disposal Method. To calculate cost savings, the Agency first determined, for each regulatory option, the number of POTWs that would shift to a new sludge use or disposal method. This required estimating the post-compliance sludge use or disposal practice using the same procedure that was implemented to estimate baseline sludge use or disposal practice. Each POTW's post-compliance sludge concentration was then compared with the sewage sludge pollutant limits for surface disposal and land application, and the same assumptions were used as discussed above to match each POTW to a sludge use or disposal practice category. Finally, EPA compared this post-regulation sludge use or disposal practice to the baseline sludge use or disposal practice to determine if the POTW did switch after compliance. As shown in Table 9-20, the regulation will lead to a shift in disposal from incineration to surface for one POTW under Metals Option 4, Oils Option 8, and Oils Option 9. No shifts in disposal practice will take place under Organics Option 4.

Calculate Cost Savings for Each POTW. The next step in the analysis was to calculate, for each POTW, the annual cost savings associated with each regulatory option.

TABLE 9-20. SHIFTS IN POTW DISPOSAL PRACTICE AND ANNUAL COST SAVINGS (REDUCTIONS IN SLUDGE DISPOSAL COSTS)

	Shift in Sludge Use or Disposal Practice from Pre-Regulation to Post-Regulation (Number of POTWs)				Annual Cost Savings
	Surface to Land	Incineration/ Co-disposal to Land	Incineration/ Co-disposal to Surface	No Shift in Sludge Use or Disposal Practice	Range ($ 1997)
Metals Option 4	0	0	1	36	$54,500 – $338,400
Oils Option 8	0	0	1	63	$94,900 – $589,700
Oils Option 9	0	0	1	63	$94,900 – $589,700
Organics Option 4	0	0	0	15	$0 – $0
Combined Regulatory Option					$149,400 – $928,100

To determine the annual cost savings of a POTW, EPA multiplied the cost differential between baseline and post-compliance sludge use or disposal practices by the quantity of sewage sludge that shifts into meeting land application or surface disposal limits. The cost differential used in this estimation is the cost savings found in Table 9-19. For the quantity of sewage sludge that shifts into meeting new pollutant limits, the Agency used the quantity of sludge, in metric tons (DMT), generated annually at each POTW.

Calculate Cost Savings for Each Regulatory Combination. The final step was to calculate the total annual cost savings for each regulatory option. To calculate the savings for a particular regulatory option, the Agency summed the cost savings of each of the individual POTWs for that particular regulatory option. As shown in Table 9-20 these estimates were then combined to estimate the annual cost savings for the Combined Regulatory Option, which range from $149,000 to $928,000. The majority of these cost savings can be attributed to the oils options, which each have an annual cost savings of between $95,000 to $590,000.

9.5 COMPARISON OF BENEFITS AND COSTS

This section compares the costs and benefits projected to be experienced by society as a result of the CWT effluent limitations guidelines and standards. The social costs of the regulation, including costs to CWT owners, CWT customers, and government, are estimated to be approximately $32.2 million. The quantified and valued benefits of the regulation are projected to range from $5.1 million to $15.4 million. A preliminary comparison of these values shows that the estimated costs exceed the estimated benefits. However, the estimation of both costs and benefits is subject to limitations and uncertainties. The limitations and uncertainties are described in greater detail earlier in this report and are summarized below.

In general, it is not possible to determine the effect of the limitations and uncertainties on the magnitude of the estimated costs. However, the quantified and valued benefits of the regulation represent only a subset of its total benefits, so the benefits are certainly underestimated.

9.5.1 Uncertainties and Limitations of Analysis of Social Costs

Several areas of uncertainty may affect the estimated costs of the regulation. For example, CWTs are assumed to offer their services and compete in multistate regional markets, which may be either perfectly competitive, monopolistic, or duopolistic. The market structure affects the distribution and magnitude of the costs of the regulation. If the markets for CWT services are larger geographically and more competitive than EPA has assumed, the model overestimates the social costs of the regulation and allocates too large a share to customers and too small a share to CWT owners. If, on the other hand, the markets are smaller and less competitive, the costs may be understated, and more of the burden may fall on customers than predicted by the model.

The elasticity of demand assumed in the model also affects how much of the costs may be passed on to customers and how much must be absorbed by owners. The model uses an elasticity of demand in competitive CWT markets (-0.5) that reflects the general range of estimated elasticities found in the literature for various types of waste management services (see Appendix E for more detail). The elasticity of demand in imperfectly competitive markets is assumed to be -1.5. Economic theory dictates that firms with market power operate in the elastic range of their demand curves. Thus, the elasticity must be above 1 in absolute value. It may, in fact, be higher or lower than assumed. If the true demand is more elastic than assumed, more of the costs will be absorbed by the CWTs. If it is less elastic, a larger share will be passed on to customers.

Because of data limitations, EPA assumes the average or per-unit cost functions for individual CWT processes is constant up to process capacity, and most facilities are operating their processes at or near capacity (that is, they do not adjust the quantity of waste treated). EPA assumes that adjustments in quantity in response to changes in costs and price take place only at the highest cost facilities. If this is not true, facilities whose CWT processes do not incur costs as a result of the regulation would be likely to increase production in response to the higher with-regulation price. Thus, this assumption may overstate both quantity and price impacts of the regulation (see Appendix D for a more detailed discussion of the cost functions).

Overall, therefore, it is not possible to determine the direction of influence of the uncertainties and limitations on the estimated costs. The following section examines the uncertainties and limitations affecting the benefits analysis and indicates the expected sign of the effect of those uncertainties and limitations on the estimated benefits of the regulation.

9.5.2 Uncertainties and Limitations of Analysis of Benefits

One general limitation of the benefits analysis, which probably results in an underestimation of benefits, is that *EPA analyzed water quality and related impacts only for a single reach adjacent to each discharge point*. The impacts of the regulation on reaches downstream and upstream from the directly affected reaches will most likely be lower than impacts on directly affected reaches, but not necessarily zero.

Many categories of benefits are not quantified and valued because of data limitations. For example, benefits of improved water quality through reductions in most noncancer health effects can only be identified, not quantified or valued, because dose-response functions for these noncancer health effects do not exist. Thus, analysts can observe whether the estimated individual levels of exposure to each chemical exceed their respective safety thresholds (RfDs); however, without dose-response information, they cannot estimate the incidence of the health effects in the exposed population. Other types of benefits that are not quantified or valued are nonuse benefits, near-stream recreation benefits, benefits to commercial fishermen, and benefits to diversionary users of the water, such as industries or municipalities that use the water for drinking or other uses. In addition, recreation-based benefits are underestimated because data were not available to estimate the angler population at one of the reaches where these benefits occur.

The analysis assumes that background concentrations of each pollutant are zero. This assumption does not affect the reductions in cancer risk, but for assessments of ecological and noncancer impacts, which depend on whether the concentration of the pollutant falls above or below a threshold level, the results are very sensitive to the accuracy of the assumption. It is unclear whether the assumption results in an underestimate or an overestimate of the impacts.

Estimation of the number of anglers using the affected reaches has not considered the quality of substitute sites. The analysis assumes anglers in a region are equally likely to fish any reach mile within the zone. If water quality in substitute sites is distinctly better (worse) than in the affected reach, then the estimates of the exposed populations are likely to be too high (low).

Anglers' responses to fish consumption advisories is very uncertain. This analysis adjusted the exposed population downward by 20 percent in reaches that had fish consumption advisories. Some studies suggest that fisherman may not change their fish consumption behavior in response to advisories. If this is true, the analysis underestimates the benefits.

The analysis assumes no behavioral changes as a result of water quality improvements. If either the perceptible qualities of the water bodies are improved or the catch improves, anglers are likely to increase their fishing activities (and thus potential exposures to remaining contaminants) in the affected reaches. If so, health benefits may be overestimated in EPA's analysis, and recreation benefits may be underestimated.

The transfer of benefit values may have led to an overestimate of values. There are two reasons for this. First, the the estimate of the value of a fishing day for the affected reaches may be too high, because water quality at these reaches is probably generally worse than the water quality in the waterbodies for which the benefits were originally estimated Second, the source of the benefit values used for measuring the increase in the value of a fishing day due to removal of all contaminants may to an extent double count the reductions in cancer risk. Also, the CWT reaches have more close substitutes than the waterbodies used in the Lyke analysis (the Great Lakes), and use of Lyke's estimates may overestimate the increased value in the CWT reaches.

9.6 CONCLUSIONS

This section has presented and compared EPA's estimates of the benefits and costs to society of the proposed effluent limitations guidelines and standards for the CWT industry. The estimated costs, approximately $32.1 million, represent EPA's best point estimate of the costs of the regulation. However, because of limitations and uncertainties of the analysis, the true costs to society may be higher or lower than the estimated costs.

EPA also estimated the values of several types of benefits of the regulation, including reductions in cancer risk, reductions in risk due to lead exposure, in-stream recreational benefits, and reduced costs of sludge disposal for POTWs managing CWT wastewater. EPA's benefits estimates range from approximately $5.1 million to $15.4 million. This chapter notes several uncertainties and limitations of these quantified and valued benefits estimates. These might result in the estimated benefits for those categories being either higher or lower than the true benefits for those categories. However, because data limitations prevented the Agency from quantifying or valuing many other categories of benefits, including benefits to near-stream recreation, commercial fishing, and diversionary users of the affected waterbodies, as well as nonuse benefits, the Agency is certain that the quantified and valued benefits represent only a subset of total benefits. Thus, EPA is confident that the costs of the proposed regulation are reasonable given the expected benefits.

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